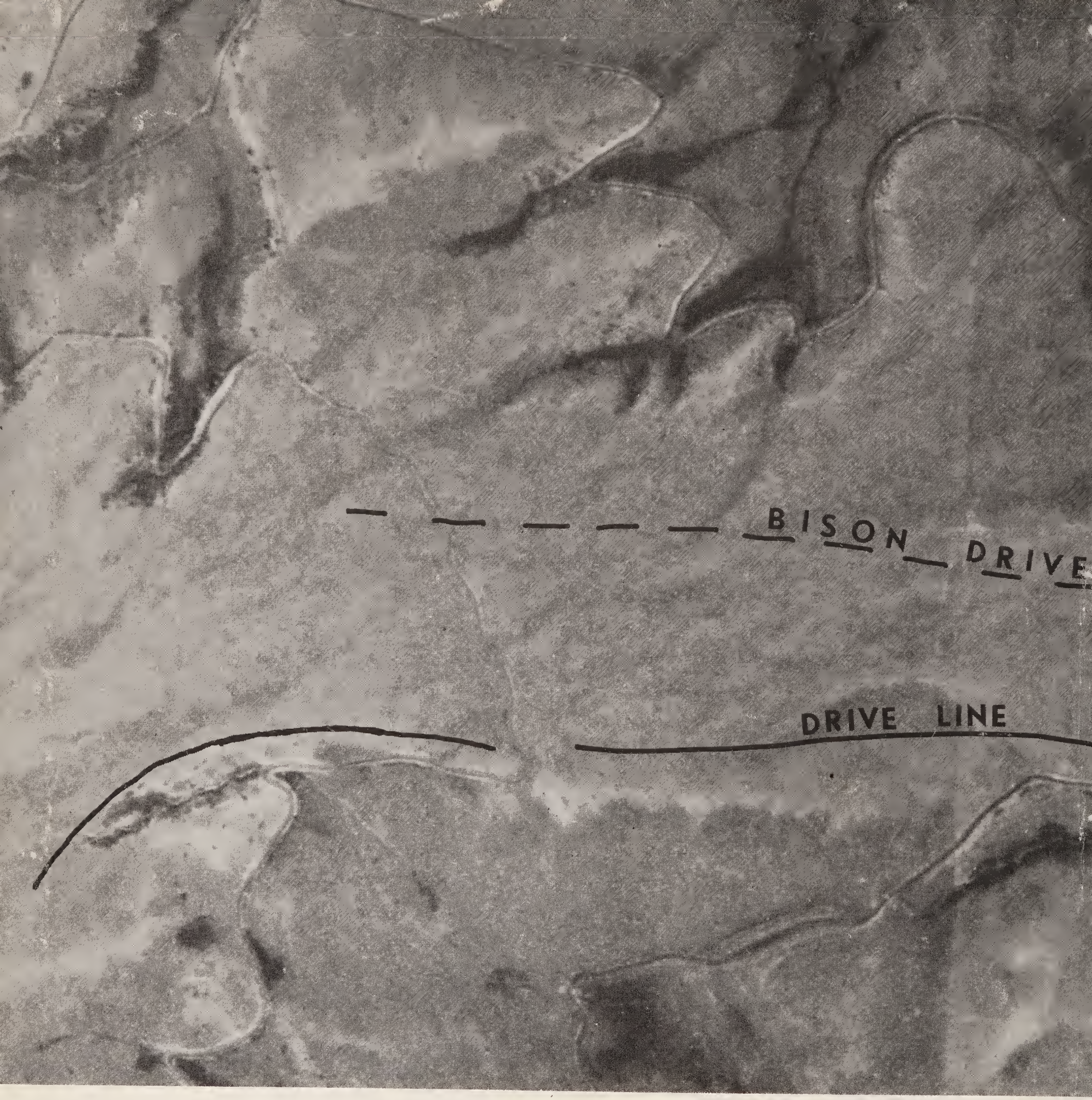
Prehistoric Hunters of the High Plains

George C. Frison



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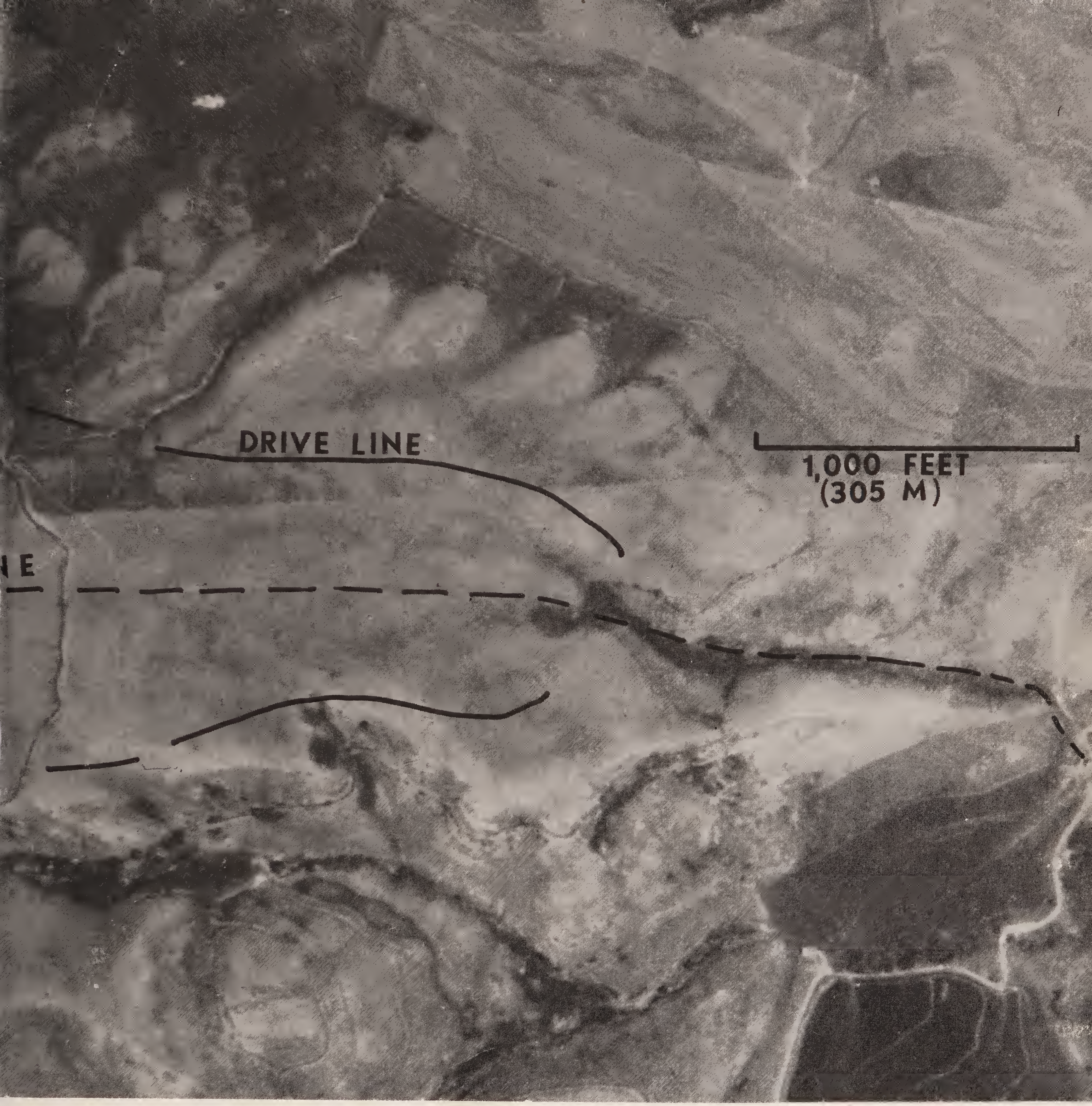

The drive line system at the Big Goose Creek Buffalo Jump.

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George C. Frison

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Preface

The Northwestern Plains are in many ways a last frontier in American archeology. Except for early surges of professional interest in such Paleo-Indian sites as Lindenmeier, Agate Basin, and Finley, until recently there has been little to spark the interest of professional archeologists. Other areas have had more to offer. As a result, systematic archeology is a relatively recent phenomenon on the Northwestern Plains.

The settlers who moved onto the Northwestern Plains from the 1880s through the 1920s brought with them a certain level of interest in their prehistoric predecessors and the artifacts left behind. The settlers were, among other things, collectors of ''curiosities.'' It was accepted practice to rifle aboriginal burials for items of interest. Rare indeed was the homestead shack or ranch house that did not have a cigar box or baking powder can filled with odds and ends of prehistoric origin. Hunters, prospectors, trappers, explorers, sheepherders, cowhands, lumbermen, and others, upon questioning, invariably recalled some unique bit of prehistoric evidence. Few reflected these phenomena however, and those who did were regarded as eccentrics. However minimal the contribution of this bygone era to present-day archeology, perforce it must be recognized as a beginning.

In the early 1930s, several events began to affect the activities of artifact collectors. The drought years denuded large areas of vegetation, and the subsequent winds removed the topsoils, leaving cultural materials exposed. Irrigation water stored behind dams, which had flooded and killed vegetation covering many major prehistoric campsites, receded as the drought continued, leaving campsites exposed. A Paleo-Indian awareness began to affect the value system of collectors: The older the artifact, the more valuable it became. Finding tepee rings and buffalo jumps did not stir much collector interest, but the possibility of finding beautifully knapped points in association with the bones of extinct animals created a surge of collector excitement. Finally, this excitement attracted professionals who arrived on the scene to excavate the sites at Lindenmeier, Agate Basin, and Finley. Work Projects Administration crews were employed in some instances to excavate a number of less well-known sites. Some of the WPA excavations were professionally directed and some unfortunately were not. This was the situation out of which systematic archeology began to emerge on the Northwestern Plains in the late 1930s. Its emergence was soon interrupted by the outbreak of World War II.

Immediately after the war, however, the construction of large dams on the Missouri River caused the formation of the Smithsonian Institution's Missouri River Basin Archaeological Salvage Program. Although this program was centered along the main stem of the Missouri River, its effects were felt up at the more distant tributaries and into the higher areas of the Northwestern Plains. Archeological surveys of proposed dam locations turned up numbers of sites. Some of these required excavation and Federal funds were provided. Regardless of its shortcomings, the Missouri River Basin Archaeological Salvage Program became, for a while, the basis of Northwestern Plains archeology.

The First Plains Anthropological Conference was held in 1931 at Vermillion, South Dakota. Three later meetings were held in 1932, 1936, and 1940, then a 7-year lapse occurred. The Fifth Plains Conference was held in 1947 at Lincoln, Nebraska where a formal newsletter was initiated. The University of Nebraska at Lincoln became the center of Plains anthropology, closely tied to the Smithsonian's Missouri River Basin Archaeological Salvage Program. The journal, *Plains Anthropologist,* was founded in 1954 as the official publication of the Plains Anthropological Conference. It faltered in 1957 but was resumed in 1960 and has become a viable journal. Since the later 1960s it has been the major forum for publication of research in Northwestern Plains archeology, deferring professional preference and priority only to an occasional article published in *American Antiquity*.

During the late 1950s, amateur archeological societies mustered enough internal support, along with small amounts of outside professional direction, to form chartered societies and institute official publications. Both the Montana and Wyoming Archeological societies began their publications in 1958 and both have continued regularly since that time. These societies have been an important factor in the development of professional archeology in these states, and their support of the profession cannot be overestimated.

The University of Montana has been active in archeological research and education since the late 1930s. The University of Wyoming started its modest program more than a decade later. The former institution has published continuously but not extensively on results of investigations. The later institution has published only minimally. Western South Dakota is undoubtedly an important area for archeological study, but investigations and publications of them there have been rare. Colorado institutions have only recently turned attention to the Plains, having been more oriented to the Southwest.

The latest developments are in the area of cultural resource management. Montana and Wyoming contain a significant share of the nation's coal, oil, uranium, and other mineral reserves. As a consequence, areas of both states are now slated for strip mining and other forms of earth disturbance. Colleges and universities in the area are involved in surveying, testing, and salvage excavations to mitigate the impact on jeopardized cultural resources of this imminent economic development. This situation has created myriad problems as well as provided sources of financial subsidy and support for intensive archeological studies.

Although never able to advance beyond the band level, prehistoric cultural groups on the Northwestern Plains were quite successful. Because of their ability to adapt, they managed to survive in an area where small changes in yearly precipitation had profound effects on the environment, and climatic fluctuations completely changed the resource bases. Many different economic strategies were tried, and succeeded or failed, in response to local differences in landforms, soils, elevations, precipitation, and other factors that affected the flora and fauna. The area has been a testing ground for human ingenuity. It now provides, and will continue to do so, an unusual opportunity to study more than 11,000 years of prehistoric hunting and gathering. Out of this is evolving a unique and viable archeology on the Northwestern Plains. Some of this archeology is presented in the following pages.

Acknowledgments

The individuals who have directly or indirectly contributed to this volume would comprise a list far too long and one that would inevitably be incomplete. It would include persons from many walks of life, but all of whom had or have a common interest in prehistoric human life on the Plains. It would include many who lack this interest but respect the efforts of others. It would include the large number of specialists who are willing to offer their expertise toward the solution of the archeologists problems.

Research in archeology requires that some institution, organization, corporation, or individual provide the necessary funds. I have been particularly fortunate along these lines, and especially acknowledge the University of Wyoming, National Science Foundation, The State of Wyoming Recreation Commission, The Wyoming Archeological Society, the Carter Mining Corporation, and the Kerr-McGee Mining Corporation who have provided the funds to support pure research. Many others have contributed in various ways for things such as basic surveys to assess cultural resources, many of which have led to manifestations of high interpretive value. To all of these persons and other entities I offer recognition and thanks for their contributions.

Most of the photography resulted from the efforts of Robert Swaim. Line drawing of artifacts was by Connie Robinson, and the maps and bone artifacts were done by Abbie Current. I thank these three for their efforts well beyond whatever compensation I could provide. In addition, photographs in Figures

A3.1 and A3.2 were taken by Paul Beaubien; the photograph in Figure A3.4 was taken by Henry Jensen; and the reproduction in Figure A3.8 was done by Mary H. Hendry.

Several items illustrated were loaned by different persons. Projectile points include: Figure 2.2d, Mr. and Mrs. B. Turk; Figures 2.2i and 2.3c, Mr. and Mrs. M. Hanson; Figures 2.4d, 5.23c, d, and 5.26a, k, Mr. and Mrs. R. Larson; Figure 3.1a, b, D. Colby; Figures 5.6b, d and 5.7e, R. Frison; Figure 5.23a, b, e–g, O. Finley; Figure 5.32c, d, W. Scoggin; Figure 5.32i, G. Fry; and Figure 5.40a–d, Mr. and Mrs. W. Darnell.

Other items loaned or given include: the Intermountain Tradition vessel (Figure 2.13) Mr. and Mrs. R. Larson; metal knife (Figure 2.18g) P. Frison; metal lance point (Figure 2.19) Mr. and Mrs. W. Darnell. L. Lahren and L. Agenbroad provided casts of points from the Anzick (Figure 5.14a) and Hudson-Meng (Figure 5.19a, b) sites respectively. B. Bradley manufactured the experimental points (Figures 9.3, 9.4, and 9.5).

Kerr-McGee Corporation donated the bison skulls (Figure 7.2) recovered in uranium mining operations in central Wyoming. The bison used in experimental butchering (Figure 8.10) was one of several donated by the Durham Meat Company from their Gillette, Wyoming herd.

1

The Northwestern Plains as an Ecological Area for Prehistoric Hunting and Gathering

The Great Plains of North America constitute a large share of the continent. Actual boundaries are somewhat flexible, depending on the particular observer. There are some places where one can almost point to a line separating the Rocky Mountains and the Plains. Elsewhere on the western border of the Plains, mountain ranges extend deep into the Plains and often form intermontane basins, obscuring the line of demarcation. The eastern boundaries of the Plains are even less distinct; there is none of the contrast formed by mountain slope and flat plain. Rainfall generally increases gradually to the east, resulting in a gradual increase in the lushness of the flora. There is no sharp line of demarcation separating short grass plains from tall grass plains and the latter from Eastern Woodlands.

Geographically the Great Plains extend from well into Canada to the Rio Grande on the Mexican border and from the Rockies to the Eastern Woodlands. The seasoned Plains traveler can always detect the subtle difference that identifies the Plains. Prehistorically the area was not the scene of any great cultural developments. Only a small part of the total area was amenable to the simple technology of Indian agriculture, a technology that was unable to cope with the root systems of Plains grasses. Also, most of the High Plains had either insufficient rainfall or too few frostfree days to allow aboriginal agriculture. This limited horticultural effort mostly to the floodplains of the rivers on the eastern margins of the Plains. The Plains villagers may have been on the threshold of greater cultural development when their efforts were disrupted by Europeans.

Integral parts of the Plains environment are various landforms, including stream valleys, uplifts, erosional remnants and other less important features resulting from geological processes. These provide relief to an otherwise monotonous and rather drab scene, and are reminiscent of oases in the desert. They often appear rather suddenly. One can ride for hours across seemingly endless rolling hills, seeing little change in flora or fauna. The appearance of a stream or spring in an arroyo changes the entire aspect of the country. Without these niches or microenvironments, the Plains would not be the same and would certainly be less bearable. Such niches were every bit as important to the prehistoric inhabitants as to the present ones—animals as well as humans. The buffalo were grazers, but they had to go to water, and they liked to stand in water and roll in dirt wallows. They sought shade on hot summer days, and they sought the protection of cut banks and brush thickets during winter blizzards. Many animals, such as deer, that were not true Plains dwellers and favored areas of topographic relief such as buttes, river breaks, and dissected mountain slopes and were important to the prehistoric Plains economy. Human survival required a planned and careful utilization of the entire ecosystem; the instinctive behavior of the animals brought about similar activities on their part.

Day-to-day life on the Plains was generally harsher than life in adjacent geographic areas. Summer sun and winter storms were—and are today—brutal, reaching intensities for which there is little protection in the natural environment. Although there are differences in mean annual temperatures from north to south, a blizzard on the open areas of the Southern Plains can cause every bit as much discomfort as one on the Canadian border. However, both the human and animal populations were able to adapt to these harsh climatic conditions.

Though the Great Plains of North America are marked by certain elements that distinguish them from adjacent areas, there is great diversity. Depending on the person's home ground, a great many descriptions of the Plains are possible. The short grass plains are different from the tall grass areas; the glaciated areas east of the Missouri River contrast sharply with areas to the west; small intermontane basins in the rain shadows of mountain ranges differ from the more open and expansive river basins. As a result there is no single cultural model that will suffice for the entire area.

For this reason I shall attempt to reconstruct the prehistoric cultures of part of what is commonly called the Northwestern Plains (Mulloy 1958; Wedel 1961). The area is more or less arbitrarily described as all of Wyoming and includes in addition the drainage of the Yellowstone and Madison rivers in northern Wyoming and southern Montana; western South Dakota and Nebraska; the extreme southwestern corner of North Dakota; and the area along the northern border of Colorado. This is an area of approximately 200,000 square miles with considerable diversity over short distances but strong suggestions of cultural homogeneity through time. There is no line or cultural boundary that will delineate the area, so it has sometimes been necessary to mention data outside the aforementioned limits. I have studied most of this area and find it extensive enough to demonstrate subtle changes in patterns of prehistoric exploitation and small enough to handle in terms of a research area.

There is no suggestion that this area is isolated culturally from adjacent areas, nor is there indication of any part that might be considered a culture center. It is merely a block of land, some of which is typical Plains and some of which is not. To take the archeological evidence found here and attempt to generalize it to other areas of the Plains is tempting but dangerous. Although outside influences on Plains cultures are obvious, some prehistoric cultures seem to have developed here uniquely and continued on their own. The same is true for any other geographic section of the Great Plains.

The Northwestern Plains of today evidence a wide variety of landforms. Mountain ranges and lesser uplifts project abruptly from the floor of the Plains. Many intermontane basins are at elevations above 7000 feet; others are at less than 4000 feet. Some areas of the open High Plains are subject to almost constant wind, whereas other areas are protected from the winds. Floral changes are rapid in response to change-in-elevation precipitation, soils, and topography. It is a unique area that requires a careful analysis to realize its potentialities and failings in providing a subsistence base for past human populations. But no amount of analysis can entirely replace a long-term familiarity with the area during all seasons. Prehistoric Plains hunters and gatherers had to deal with the adverse times of year as well as with favorable ones.

It is tempting to place the events of the past entirely within the limits of present conditions. The archeologist must remember that the surface of the land has changed in various ways through time as a result of climatic changes. Short-term changes as well as long-term changes have significantly altered the landscape. There are deep, perpendicular-sided arroyos now where gently sloping, sodded swales were present a half-century ago. The dust bowl years of the 1930s changed the looks of the Plains as well as their livestock carrying capacity for several years. We can only hypothesize what the Plains looked like before the Europeans came, when Upper Republican sites were covered with a thick mantle of loess (Wedel 1961:101). In the Late Archaic period some arroyos were aggrading and presented a meandering pattern with shallow banks; now they are marked by deep, perpendicular banks and a much less meandering pattern. Trapping bison with the landforms present then (Albanese 1971; Frison 1971a) and now are different matters.

Another example is provided by an area where mammoths were killed in the Big Horn Basin of northern Wyoming. The geology of the area indicates that the arroyo was then steep-sided and at least 30 feet wide with banks about 30 feet or more high. Today the same area is drained by a shallow, meandering arroyo with gently sloping banks. The presence of mammoth in an area that today supports only small sagebrush, greasewood, and occasional bunch grass also suggests significant floral changes. Although the major features of the macroenvironment such as the mountain ranges, intermontane basins, and stream valleys remained relatively unchanged through Holocene times, the microenvironmental changes have been many and significant during the same period and all have affected man's occupation of the area.

The Altithermal period (Antevs 1948, 1955) or Atlantic Climatic episode (Bryson *et al.* 1970) must have greatly affected the area. Vegetative cover had to be drastically changed judging from the light-colored paleosols with evidence of desiccation and concomitant lack of fauna and human occupation (see, for example, Leopold and Miller 1954). Extensive sand dunes now stabilized by vegetation demonstrate evidence of past activity in the form of such features as old parabolic dunes formed under conditions of past sand transport. Some of this activity may be Altithermal in age, although sand activity is very sensitive to other climatic changes and could be the result of short-term droughts and not the result of the extended arid conditions of the Altithermal period. Lowering of water tables during the Altithermal period may have been the cause of much gullying.

There is actually no stereotype Northwestern Plains environment, either past or present, because of the wide variety of landforms, flora, and fauna. Nor can we consider the mountains without considering the Plains or vice versa; neither one by itself is sufficient as a basis for intelligent discussion of the prehistory of the area. The prehistoric occupants did not make these kinds of distinctions and neither can we. Mountain ranges, minor uplifts, intermontane basins, major rivers, high-altitude plateaus, and many other landforms are intruded into the Northwestern Plains, and all form a part of the natural environment that was utilized by the prehistoric inhabitants.

Even the Plains areas within the Northwestern Plains are varied over short distances. In the southern part of the area shown in Figure 1.1, the Laramie Basin in southeastern Wyoming is over 7000 feet above sea level and is composed mainly of rolling hills, with some areas of "breaks" or rough, dissected landscape. There is a good grass cover, with some patches of sagebrush and greasewood, over much of the area. Playa lakes are common, although other lakes may hold water continuously or nearly so.

Moving west into the Wyoming Basin in south central Wyoming, we find that elevations are lower and the grass cover not as good as in the Laramie Basin; more sagebrush is in evidence. This area is marked by some extremely rough country caused mainly by the deeply trenched North Platte River and its numerous tributaries. Further west, the Upper Green River Basin is still in many ways a Plains environment, with elevations of 7000 feet and above; there are extensive areas of tall, thick sagebrush.

To the south of the Green River Basin, the Green River flows into rough canyon country on the northern periphery of the Southwest. The Uinta Mountains, mostly in Utah, bring an end to the High Plains-like country of the southern Bridger Basin located in extreme southeast Wyoming. Further West is the divide where the rivers drain west into the Great Salt Lake. The Salt River Range on the Wyoming–Utah border forms the western border of the Green River Basin. To the north the character of the country changes from plains to

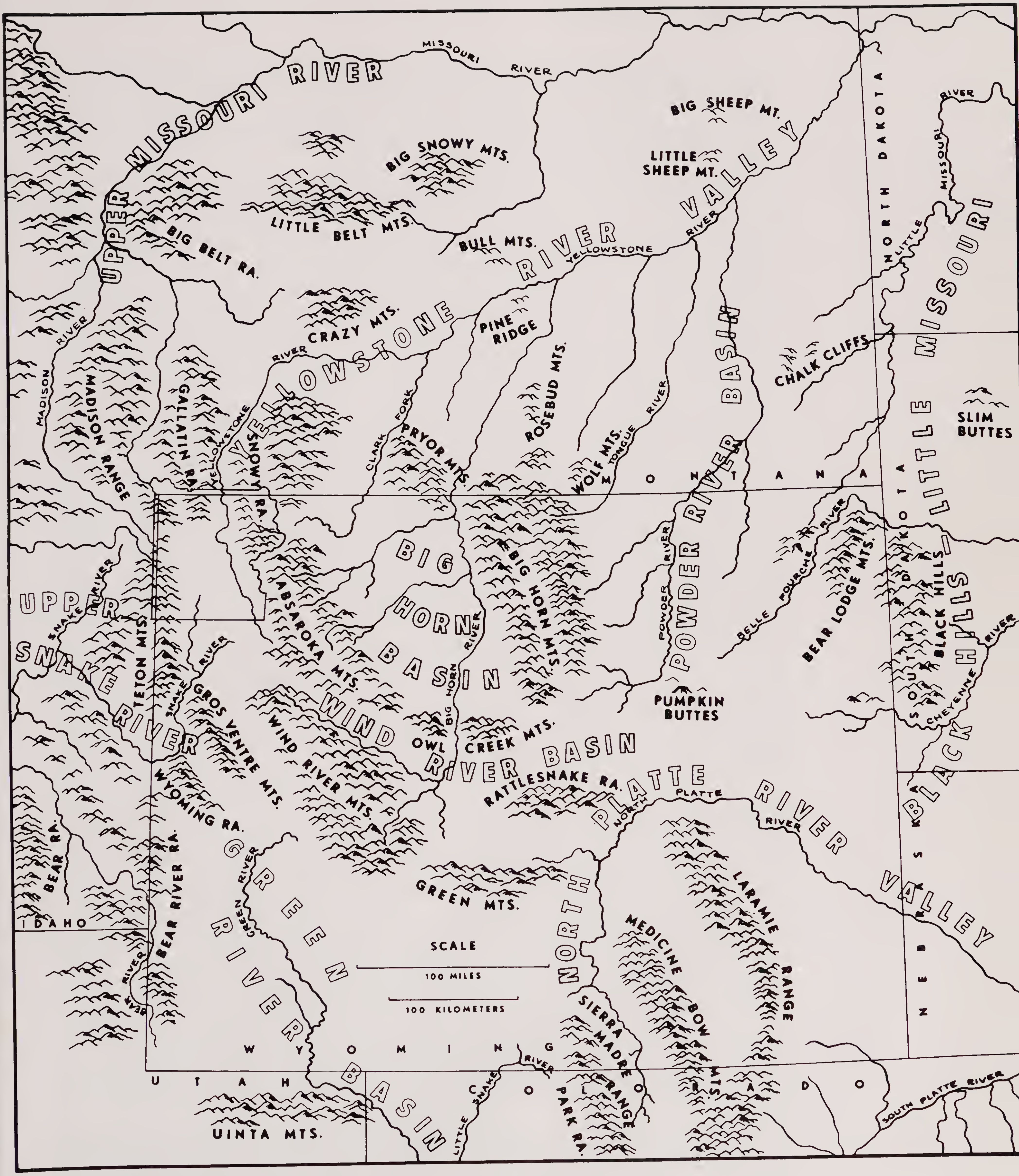


FIGURE 1.1. The Northwestern Plains as covered in this book, with extensions to the Missouri River and Upper Snake River areas.

mountains in that part of Wyoming where the Wind River Mountains, the Gros Ventre Range, the Absaroka Mountains, and the Teton Range encircle Jackson Hole and the Upper Snake River drainage, which flows westward to the Columbia River. For all its mountain character, there are open, sagebrush-covered flats bordering the Snake River in Jackson Hole.

The Snake River Plain in southeastern Idaho presents an ecological and archeological situation that may bear close relationships to the Northwestern Plains when the prehistories of both areas are better understood. Yellowstone Lake, a large body of water at 7200 feet, drains north and forms a source for the Yellowstone River which flows north into Montana then turns east and flows diagonally across Montana and meets the Missouri River at the Montana–North Dakota border. The Madison and Gallatin rivers also begin nearby and being east of the Continental Divide, flow into Montana and then directly north to Three Forks and the beginning of the Missouri River.

The Plains-like country rises even higher to South Pass astraddle the continental divide in southwestern Wyoming at the southern end of the Wind River Mountains and then merges with other Plains-like areas along the Sweetwater River and the Wind River and Shoshone basins. To the east of an imaginary line connecting the southern end of the Bighorn Mountains and the northern end of the Laramie Range is a true Plains environment of open rolling country along the Platte River and the upper drainages of the Cheyenne, Belle Fourche, and Powder rivers. The first two flow east to the Missouri River and the latter flows north to the Yellowstone River.

A unique enclave of the Northwestern Plains is the Bighorn Basin, lying between the Bighorn, Absaroka, and Owl Creek mountains in north-central Wyoming and the Pryor Mountains in southern Montana. The western and southern parts of the Bighorn Basin are reasonably good grasslands, but the eastern part at the base of the western slopes of the Bighorn Mountains is extremely dry and closer to a Great Basin environment than that of the Plains. The Bighorn Basin, however, grades into a true Plains environment north in the area of the Clark Fork of the Yellowstone River and northeast through the gap between the Pryor and Bighorn mountains and from there through the vast stretch of country bounded on the south by the Yellowstone River.

The character of the Northwestern Plains changes markedly to the east of the Bighorn Mountains along the drainages of the Little Bighorn, Tongue, Powder, and Little Missouri rivers in southern Montana and northern Wyoming. Here there is more moisture and grass is higher and thicker. The area is marked by buttes, escarpments, and shallow but rough canyons covered with sagebrush, ponderosa pine, and juniper. Mesas are a common feature and the entire area in general supports excellent stands of grass. In southern Montana are several important geomorphic features including the Wolf and Rosebud Mountains.

The Yellowstone River and its wide valley comprise a special part of the Northwestern Plains. The stream valley has several broad terraces, and tributaries provide rough country; bluffs and escarpments are seen on both sides of the valley. The Yellowstone River and its major tributaries provide a natural entrance from the east into the heart of the Northwestern Plains as does the North Platte River further to the south. The drainages of the Yellowstone River east of the Bighorn Mountains include some of the best grass country—and consequently in the past some of the best buffalo country—known for the entire plains. Elevations are lower and winter climates are less harsh than those of some of the higher intermontane basins.

The Black Hills area of Wyoming and South Dakota provides another somewhat special environment. Rising out of the Plains, the area attracts more rainfall than surrounding areas. The flora is unique and heavy stands of oak and ponderosa pine predominate. Scattered throughout are open parks with excellent grass, although the higher elevations are deeply dissected and covered with heavy brush. A number of small streams make the Black Hills a true oasis-like environment.

Between the Black Hills and the Laramie Range is an area of open plains with occasional minor uplifts such as the Rochelle Hills, the Pumpkin Buttes, and the Pine Ridge escarpment extending eastward from the northern part of the Laramie Range. The Hartville Uplift begins just east of the North Platte River in eastern Wyoming and extends northward to the vicinity of Lusk, Wyoming. Just south of the North Platte is another landmark known as Goshen Hole, a depression 100 or more feet deep eroded out of the High Plains. This is another excellent grass area with good protection from the constant wind. The buttelike country, with some long, steep scarps and brushy canyons, extends well into western Nebraska before the more flat, typical Plains area begins.

Many lesser features add variety to the topography of the Northwestern Plains. There are geological faults, deeply eroded sandstone formations, and sand dune areas. Moisture falling on large sand dune areas often comes to the surface in interdunal ponds, which provide water and green feed to animals who seek out these areas.

Major mountain ranges, such as the Bighorns, Absaroka, and Wind River ranges have steep and deeply dissected slopes. At higher elevations (about 7500 feet), there are relatively flat, open areas that support excellent grass along with tall sagebrush and occasional stands of timber. At even higher elevations, where thick stands of timber begin, there are numerous open grass parks that provide feed during the warmer months. Above the timberline there are thick stands of grass, and though much of the country is extremely rough I have seen bleached bison skulls at elevations above 13,000 feet. Occasional evidence of prehistoric occupation is also found at such high altitudes.

It is difficult to describe a true Northwestern Plains environment. Nevertheless there is a distinctiveness. In most of the Northwestern Plains one can climb to the top of a rise and on a clear day see some form of uplift or mountain range in the distance—which is in sharp contrast to the view from the open Plains. The wind is almost incessant and usually blows from the west. Violent changes in weather are always to be expected. Long, cold winters and short summers lead to a short growing season, and where water is scarce grass is short. Early warm spring days give a false promise of continuing good weather but spring blizzards can be more deadly than those of winter. Indian summers seldom linger very long and are usually cut short by snow and cold weather.

It is not an area that even under present technology can support large human populations. Domestic livestock operations rely on irrigation and crops adapted to high altitudes and short growing seasons for sufficient feed during the long, hard winters. There is little to recommend the Northwestern Plains as a place to live, but its uniqueness did foster some distinctive cultural patterns in prehistoric times.

THE SUBSISTENCE BASE

The main source of subsistence on the prehistoric Plains were a variety of grasses, forbs, and shrubs that supported a grazing and browsing mammalian fauna, which in turn provided for a small number of human groups sometimes rather precariously perched at the top of the food chain. The short, sparse grasses are deceiving. They appear to the traveler to be incapable of supporting life, but are actually rich in available protein. Grazing and browsing animals are well adapted to their intake. These animals can survive and maintain excellent body condition here as well as in areas where there are large quantities of lower protein grasses.

The present-day livestock operator has more descriptive terms for grass than the polar Eskimo has terms for snow, and each type of grass results directly from weather conditions. Moisture and temperature determine grass conditions; perhaps the former is most critical. Wet, cold springs usually produce better grass than hot, dry springs. Heavy spring snow or rain followed by warm days produces the large quantities of nutritious grasses that rapidly bring the animals out of the long, downhill physiological trends of winter. No artificial feeding program yet devised can replace green grass as a means of reviving metabolic processes of grazing and browsing animals.

Although spring storms help the grass, they can be devastating for the animals, especially with combinations of deep snow, wind, and low temperatures. Spring is bison birthing time, a particularly critical period even though bison are surprisingly tough. A calf born in a snow bank has a good chance of surviving if temperatures do not drop too low for prolonged periods. Once on its feet, dried off, and suckling, its chances are good even though temperatures may drop to 0°F and below, a possibility even in April. Deer and antelope young are born in May and June. However, May and June blizzards do occur and can also be unpleasant.

Ideal grass conditions result from a warm, moist spring followed by enough summer moisture to bring the grass to slow, even maturity. Hot, dry periods, even after an ideal spring, force early maturity and poor seed development. Dry, brittle grass breaks off easily from movements of animal herds and is consequently lost.

Because the critical element is moisture, and precipitation differs over short distances in the Plains, grass production is not uniform over large areas. Also, an area good one year may not be good the next. Hailstorms can denude large areas of grass, causing the grazing animals to shift locations from year to year or even during a single season.

Dry years and short grass have many negative effects on grazing animals. The number of offspring can be directly correlated to animal conditions, which is dependent on food supply. Bison calf crops especially suffer if animals are unable to achieve a certain level of conditioning. The teeth of grazing and browsing animals are also adversely affected by poor grass. Grazers and browsers are able to survive only as long as their teeth last. When grass is abundant the animal can fill its belly without grubbing the grass close to the ground and so does not take in as much particulate matter, which breaks off and grinds incisor and molar teeth. Poor grass years also force animals to ingest greater quantities of coarser feed. As the animals approach old age, the incisor teeth no longer present a straight, uninterrupted occlusal edge. The grinding ability of the molars decreases as the teeth wear away and the enamel-lined selenes or crescents narrow and finally disappear, as does the external tooth enamel. Stems of mature, tough Plains grasses slip between the worn incisors and cannot be torn loose from the plant. Grass is also forced between molar teeth instead of being ground on the occlusal surfaces. The animal is unable to eat and dies. Lush grass and easy winters, however, may give the animals a year or so's reprieve. The average life span of range cattle and sheep in the sparse, short-grass area of the dry Red Desert of south central Wyoming and Bighorn Basin area of north central Wyoming is about a year less than in the Yellowstone River Valley and Powder River Basin areas of southern Montana and northeastern Wyoming, where grass conditions are better.

In order to view the Plains as an ecological area, we must understand both the nature of the vegetation and how it is utilized by the animals. The Plains are characterized by different kinds of soils and topographic relief. Heavy clays or "gumbo" soils support bunch grass; buffalo grass favors the areas of well-drained light soils and sandy soils; low-lying, saline areas provide conditions favorable for the saltbush. River bottoms and arroyos with intermittent watercourses are favorable for a wide variety of tall, coarse grasses, trees, and shrubs.

The year-round patterns of plant utilization are in general the same for all grazers and browsers, although some minor variations may be unique to an individual species. The grasses begin to grow in the early spring and the animals, desperate for green feed, have sometimes been known to run themselves to death in order to find it, especially if they happen to be weak from a hard winter. This is the time when a good many animals die anyhow, strangely enough after they have managed to survive the long, difficult winter. After the grasses grow enough to provide sufficient feed, the animals begin to lose their winter coats of hair. In a short time they have regained their strength and begin to replace the fat lost during the winter. Females drift off to prepare for the birthing and the males usually congregate in groups, displaying little or none of the belligerent behavior of the rutting season that follows. Extremely old males may remain solitary.

Spring rains usually provide enough moisture to give the Plains a false appearance of lush abundance for a few short weeks, and this is a good time for the animals. Feed and water are everywhere and conditions are ideal. The young are growing fast from the soft grass and good supplies of mother's milk. The days are warm and nights are cool; insects are not yet about in quantities. One hardly recognizes the sleek, healthy animals, listless and sickly only a few weeks earlier. Even the very old, with teeth nearly gone, that barely made it through the winter can ingest sufficient grass and maintain good condition well into the fall.

It is not long, however, before the pleasantly warm days of spring turn into the hot days of summer. Spring ponds and watercourses begin to dry up and disappear; plants are suddenly forced into maturity while there is enough ground moisture to produce viable seeds. Animal utilization patterns of the Plains flora change. Longer and longer treks to water are necessary as the available feed around ponds and springs is consumed, and the number of water sources decreases. The animals change to a pattern of early morning and late evening grazing to avoid the midday heat and the clouds of insects. Buffalo seek mud and dirt wallows and shady places. Another favorite spot is a clump of trees in a high place, where the breezes can circulate freely. In areas close to mountains many larger species move to the higher elevations for the summer.

As the grasses and other plants mature, the character of the Plains changes gradually from green to brown. A blindfolded person can sense the difference as the inevitable afternoon winds carry the smell of curing vegetation. This critical change in the nature of the vegetation brings about subtle changes in the animals. Their protein intake is comparatively higher, because the seeds are now mature and the stems and leaves of the plants have less moisture. This is the period when the animal begins to lay on the layers of fat so necessary for winter survival. At the end of summer and early fall, with hot days and cool nights, the animals are in prime condition. Long strips of fat are found along the top of the back from the tail to the shoulders, in thick layers on the brisket and ribs, and in the form of long strings and blobs of loose or ''gut'' fat in the intestinal cavity. The hump of the buffalo is choice with alternating layers of fat and flesh. The true meat hunter knows that this is the time when the animals are best and will loudly and justifiably proclaim the excellence of ''grass fat'' meat obtained at this time over the artificial products of forced feeding in a modern feedlot.

The rutting season begins in midsummer and lasts through fall. Buffalo have a gestation period of about 280 days and usually begin the rut in late July. Pronghorn have a gestation period of about 252 days and begin the rut about a month later than the buffalo. Deer, with much shorter gestation periods, rut later in the fall. Rutting periods change the animal behavior patterns. Docile and retiring males that once avoided the nursery herds become belligerent and aware of the females. The rut is short, however, and when it is over the males revert to their former behavior.

On the High Plains, especially, the salubrious days of late summer usually terminate abruptly. One day may be warm and sunny, and the next can bring cold winds, snow, and even blizzard conditions. These first storms never last but are signs of winter not to be ignored. Changes in animal behavior can be detected. Summer coats are lost and gradually replaced with the heavier ones of winter. Animals are more in evidence during the day because the weather is cooler and insect hordes have decreased. Antlers and horns have been brought to top condition and the results of this are evident by numerous shrubs and small trees with the bark and branches rubbed and twisted into various shapes. A male deer or elk will attack a small tree or several shrubs in a thicket and literally strip all the bark and leaves while removing the velvet and polishing the tines of its antlers. Bison will go into a thicket of long, slender willows and encircle a number of trees with a horn. With a circular motion of their heads, they form bundles of branches several feet long resembling giant pieces of twisted cordage.

As fall progresses into winter, snow becomes deeper and the weather colder. The animals are more in evidence, largely because their habitat is reduced and also because there is less vegetation in which to hide. As long as the higher concentrations of grass along the bottoms of streams and arroyos are available, the grazers will take advantage of it. As the arroyos fill with snow and the snow becomes too crusted, the animals move to the bare, windswept ridges and southern exposures where feed is available. In the dead of winter feed generally becomes scarce. The animals use up their fat reserves and exploit the less desirable food sources. If the winter is really severe bison will eat willows, cottonwood, and branches of other trees as large in diameter as a man's thumb. They also will eat yucca leaves (which are little more than heavy twine with a small amount of not very nourishing filler), and tall, coarse grasses such as Canadian wild rye (*Elymus canadensis*), which grows to heights of over 6 feet and is usually ignored entirely because of its low feed value. Bison use their large head to push away the snow while other grazers paw the snow with a front foot to expose feed.

Extended periods of below-zero weather are particularly difficult. This is the time when the old, the sick, and the crippled begin to die or fall to predators. Occasionally the conditions are so severe that some healthy animals die before the arrival of spring. Winter culls the old and the weak, and it is the bad winter following a summer of sparse vegetation that is disastrous to the grazing and browsing animals. When the situation is reversed and a summer of poor grass follows a bad winter, the animals' condition never improves sufficiently for proper breeding to take place. The next year's crop of offspring is consequently below normal. In addition, animals going into a normal winter in poor condition are apt to be in serious trouble before green grass appears the next spring.

THE HUMAN GROUP

Prehistoric life on the Plains was not gentle for the prehistoric hunter. Human skeletal material is not plentiful on the High Plains but what there is strongly indicates that long life was not one of the concomitants of these hunting and gathering groups. A life span of 40 to 50 years was probably all the average Plains hunter could look forward to. This means that for about 20 or 30 years the prehistoric Plains hunter maintained a family and acted as the head of a family group.

On the basis of analogy from ethnological studies, we can conclude that concepts of territoriality must have been present with prehistoric Plains hunting groups. Hunters and gatherers favor patterns of economic exploitation in areas they are familiar with. Locating animal or plant resources in unfamiliar territory is a difficult task. Animals are predictable within limits, and familiarity with a territory means that the hunter has a chance to observe the way the animals behave in a given area. He can then apply the hunting strategy that has the best chance of success. The same is true of the floral resources. It takes a long time to learn where the berry patches, seeds, greens, tubers, roots, and other resources are located and when they are available.

Many times during the year the prehistoric human group had to pack up all personal belongings and move. A dry year resulted in different patterns of distribution of plant and animal resources, and the human groups had to respond accordingly. Other factors such as infestations of insects, intensity of runoff water affecting stream crossing, and time of snow melt on mountain passes could also have caused changes in yearly food procurement patterns. These would have been short-term events. Major climatic changes would have resulted in long-term events that changed the entire settlement pattern.

It seems very likely that a prehistoric family group of hunters and gatherers may have moved camp as many as 50 to 100 times during the year. They probably tended to revisit the same campsites or campsite areas from year to year. Water was always an important consideration on the Plains during part of the year and many campsites were close to water. Sites on buttes and high spots were favored by some of the groups. Ultimately the prehistoric Plains family left a large number of campsites of different duration and purpose, manifested by differing amounts of cultural evidence. To express it another way, there are different degrees of archeological visibility regarding these cultural manifestations.

We can estimate that every prehistoric Plains family or social group must have contributed several hundred campsites to the archeological record. Multiply that number of the number of families or groups that could have occupied the Plains over the known 11,000 years of human occupation on the Plains and the result is a large number of potential archeological sites. However, we know of only a tiny fragment of this total.

It is immediately obvious that most archeological sites on the Plains have left little evidence of their presence. Suppose a man and his family, or more than a single family, camped at a location for a single night. Very likely a pit would have been dug, a fire would have been built, and some food prepared. Some sort of shelter was probably used, depending upon the weather and the time of the year. And, depending on the nature of the activities performed, there may or may not have been some stone tools used or manufactured that might have left some evidence of the episode. If the site was rapidly covered over as the result of some geological process, it might some day come to light and be used as archeological evidence. On the other hand, if it was not covered, the wind would disperse the charcoal, bones would disintegrate, and the edges of the fire pit would crumble. Over a long period of time only a few flakes and perhaps a broken tool would remain. And unless the tool was diagnostic of a time period, the chronology of the event would be lost. We might be able to say something about the function of the tool, but that is all that could be said about the site. There are many sites of this nature, and without the methodology to handle such data our knowledge of the prehistoric Plains hunters will suffer. Archeologists base their interpretations on a small fraction of the total evidence. What is usually found on the Plains is the large animal kill and less often the large campsite. Sites of low visibility that consist of, for example, a few flakes, a broken tool, and a few fire-fractured rocks can tell us a good deal if the proper methodology is developed.

There is sufficient evidence from both archeology and ethnology to confirm the past use of plant food resources on the Plains. How much such resources contributed to the total food supply is conjectural, but it was undoubtedly significant. The availability of plant food for human groups changed throughout the year, as it did for the animals. Early spring in the Plains is the time for tender shoots of plants and greens. Fruits and berries begin to appear in late spring and continue into early fall. Spring is the time also for certain roots and bulbs. Grass seeds usually mature in late summer but vary with available moisture. Some seeds are dispersed by wind, animals, or other natural agents shortly after maturity, and some are retained on the plants well into the winter—such as the seeds of the saltbush (*Atriplex* sp.). Some, such as the seeds of the limber pine (*Pinus flexilis*), are available only for short periods of time, as when the cones open in late summer. Fruits and berries appear and disappear rapidly, but since the same plants often grow at different elevations, they may be mature at one elevation and immature higher up.

Human plant food resources are limited in winter and consist mostly of a few seeds, fruits, and berries remaining on plants, a condition that varies from year to year. For the prehistoric Plains hunter–gatherers, the best insurance for the winter was food gathered and stored during summer months.

The evidence strongly indicates that prehistoric economic activities were seldom limited to any given life zone. In fact, the opposite is more often the rule than the exception. Narrow economic specializations were often the road to disaster, and hunting and gathering is proposed here as having best characterized most of prehistoric life on the Northwestern Plains.

2

The Archeological Record for the Northwestern Plains

THE CONCEPTUAL BASIS

Archeologists are concerned with, among other things, the temporal and spatial aspects of prehistoric human occupations. The chronological sequence is first determined and then, if it is possible, the areal parameters are added to each separate entity in the stratigraphic sequence of cultures, whether the investigator is dealing with a small area or a large one. Depending on the nature of the evidence, it may then be possible to analyze and interpret further, to formulate hypotheses and models defining the institutional and systematic aspects of the various cultures involved. Working toward these ends might be called *cultural anthropology* or perhaps *archeology as anthropology*.

Whatever the ends, the procedure used is important. Data must be gathered and the data involved must come out of a geological context that is usually referred to as the site. Every site is unique and requires a specially formulated research design. Unfortunately there is no written source the archeologist can fall back upon to tell him exactly how to investigate a site. Methods of recovering and recording archeological data are continually changed and hopefully improved by innovative investigators.

Chronology always emerges as a central theme in archeological studies. Time–space charts are an integral part of most final reports because they provide a convenient way to summarize results. They also provide an open-ended framework upon which revisions can be made as new data are found.

ESTABLISHING THE CHRONOLOGY

Chronological sequences have been aided immensely by radiocarbon dating. But perhaps archeologists have become entirely too dependent upon radiocarbon dates derived from charcoal, bone, and other organic material. There is a tendency to emphasize the dates that fit preconceived ideas and to minimize other dates. Even so, if enough radiocarbon dates are eventually run, statistical means can be used to eliminate those that for some reason are incorrect. With further improvements in radiocarbon dating, reliable absolute chronologies may be built on radiocarbon dates alone.

Two other important concepts used to formulate relative chronologies are typology and stratigraphy. The former is used to describe observable and quantifiable changes in cultural materials through time; the latter is used to define their relative geological position. The two are separate concepts, but in many archeological contexts they operate together and are inseparable. The uses and abuses of typology in the study of archeology have been the subject of many discussions, and have resulted in a great amount of dissent, criticism, and actual enmity among the ranks of professional archeologists. Much of this appears to stem from a problem of semantics. Wormington stated many years ago (1957) that "if type names are to serve as a means of communication, it is essential that the reader and writer attach the same meanings to the words [p. 3]." Certainly this is essential if intelligent and unemotional discussions of typology are to be possible. In this presentation, I regard artifact types as heuristic devices. They are used as temporal indicators in much the same sense that index fossils are used by the stratigrapher. In addition, there is no sorrow in abandoning a type name when it proves to be of no further use.

The archeologist who works in areas of high relief and sparse vegetation usually finds himself doing things that belong to the province of geology, a subject in which few archeologists are adequately trained. He also finds some of his common terms of reference, such as *assemblage* and *component,* to be inadequate and inappropriate. For example, he may find that the activities associated with a particular bison kill in an arroyo took place over a variety of land surfaces of varying degrees of stability. Subsequent erosional events may have left the artifacts distributed in unique ways within a geological formation. Consequently, interpretations of past cultural activities in this case are strongly dependent on geological expertise. Colluvial deposits may contain archeological materials deposited secondarily as slope wash, but other artifacts will be *in situ* and the investigator must be able to distinguish between the two. Cultural deposits in sites of this nature undergo many kinds of changes evident only to the geologist.

Continued exposure to these kinds of archeological–geological site manifestations led to a proposal for the use of the geological term *facies* as more appropriate than the archeological term *component.* A further idea was to modify this and call it *technofacies* (Frison *et al.* 1974), which would in one sense unite *assemblage* and *component* into a single term useful to students attempting to establish temporal and spatial aspects of human occupations while working with archeological–geological manifestations.

Although the term *technofacies* will probably never achieve widespread usage, I think it has merit. Stratigraphic units, both in a geological and archeological sense, usually demonstrate more than one aspect and each can be regarded as a facies. The archeological assemblage is of human conception and manufacture, which suggests a technological process. Variation within a technofacies reflects such things as individual abilities and preferences, whereas intertechnofacies differences reflect such things as functional differences in tool assemblages resulting from different kinds of cultural activities.

The number and kinds of things that have resulted in differences between cultural assemblages within a single stratigraphic unit are therefore many, but there is still enough internal consistency for typology to be useful as a temporal indicator and a functional use determiner. Studies of function of tools and weaponry in archeological contexts have proliferated through experimentation and use and wear pattern analyses. Studies of stone flaking technology as a cultural process—rather than mere replication of prehistoric exotic materials—have added a new understanding to typology. We find, for example, that what have often been described as discrete types and styles of chipped stone tools are actually a single type or style at different stages of manufacture or use. We find also that some tools were used at different stages of their manufacture and did not always reach what some investigators have considered a final stage. Tools were also changed as a result of use. When projectile points were broken, usable pieces were often modified, and what emerged from the process had little resemblance to the original although function remained unchanged (Frison *et al.* 1976:41–46). But sometimes broken projectile points were reused as tools. And most tools were designed so that as points or edges were dulled they could be rejuvenated through some kind of resharpening process. This resulted in a continual attrition of the object until it was no longer functional for its original purpose and was discarded or made into a tool having an entirely different function. In the process, the object acquired different configurations and the function associated with each must be recognized if its contribution to the ongoing cultural system is to be recognized (see, for example, Frison 1968b).

Here experimental archeology is proving of great value. Although we can never achieve exact past conditions, we can establish some limitations and possibilities. We have found, for example, that a projectile point must have a proper design to penetrate the rib cage of a bison. We have also found that in the process many things that happen are predictable and can be interpreted from an examination of the utilized projectile point and remaining fragments. Breakage as the point impacts, for example, leaves a different kind of flake debitage in the deposits than those resulting from tool sharpening. We now know some of the limitations on the butchering process imposed by the use of stone and bone tools compared to an assemblage of metal tools. From such experimental–functional studies, better descriptions of past lifeways are appearing. In this sense typology is not a narrow study destined to be an end in itself. On the contrary, it is an ever-expanding means of inquiry into other aspects of culture. The use of the technofacies concept mentioned earlier often appears in essence if not in actual name in discussions of cultural deposits in archeological–geological contexts found on the Northwestern Plains. Types are not equated as cultures but are used only to find out more about cultures. They are arbitrary constructs but this does not negate their usefulness.

Holocene stratigraphy is still very much an incomplete study. Few if any archeologists are competent stratigraphers, so they are forced to rely on the expertise of a small number of geologists who specialize in Holocene stratigraphy. A chronology of some postglacial valley terraces was proposed (Leopold and Miller 1954), but erosional and depositional events change from one watercourse to another so that terraces along one live or ephemeral stream of a given order do not necessarily correlate with others. Older Holocene alluvial deposits have been removed entirely from some valleys but remnants of such deposits can be found in other valleys. The geologists themselves admit that with the present state of knowledge, the reasons for this are not always clear and that such phenomena are not predictable within satisfactory limits. As a result, the preservation of many important archeological sites, especially those of the Paleo-Indian period, seems to have been entirely fortuitous. One attempt at a general correlation of late Quaternary alluvial deposits over the Plains and the Southwest based on stratigraphy, radiocarbon dates, and projectile point types was attempted by Haynes (1968).

Known Altithermal period deposits in open sites are rare. Cave deposits for this period are known (Wedel *et al.* 1968) but difficulty is usually encountered in relating cave deposits to conditions outside the cave. In many cases, the Altithermal period seems to have been one of general degradation so that archeological materials in open sites are seldom in context. One exception is a stream bank site (the Laddie Creek site) on the western slopes of the Bighorn Mountains. In this case, stratified cultural deposits of Altithermal age resulted from the emergence of springs (Karlstrom 1977). Soil studies are being closely correlated with geological studies, and a number of radiocarbon dates for the Altithermal period are now available. There are many indications that Altithermal period conditions varied greatly over short distances, so that local chronologies for the period will be necessary to understand conditions as a whole.

Post-Altithermal geology is not well known either. A key to prehistoric changes in landforms is often found in large animal kills where older deposits are preserved in datable contexts (see, for example, Albanese 1970, 1971; Mann 1968). These indicate significant changes in topography within the last 4500 years. I must emphasize that erosion rates are high in the Northwestern Plains, primarily because of the considerable topographic relief and sparse vegetation. A good share of the yearly moisture comes in the form of gullywashers, and summer–winter and night–day temperatures vary widely. I have during the last few decades observed extreme changes in many areas due to rapid headward erosion of arroyos. The causes of such erosion are not well understood, and those studying the problem frequently disagree on the nature of probable causes. Headward arroyo erosion can be observed in the form of box canyon-like features with perpendicular walls from less than a meter to several meters high in the bottoms of arroyos.

The archeologist and the Holocene stratigrapher are dependent on one another. The archeologist is able to provide relative and often absolute dates for stratigraphic units. The geologist is then often able to reconstruct landforms that may have had considerable bearing on the cultural activities of the time represented. Human artifacts serve as index fossils where materials for radiocarbon dating are lacking. Soil scientists, palynologists, and paleontologists can utilize the same chronological data to establish climatic, plant, and animal successions of the Holocene. In this way, Holocene chronologies as well as many other ecological factors are becoming better established in some areas.

Prehistorians on the Northwestern Plains are probably more concerned with stratigraphy and typology than those in many other areas. In the first place, the stratigraphy is exposed and therefore obvious. Secondly, the stratigraphic record reveals a succession of cultures all of which operated at about the same level. Culturally these were band-level hunters and gatherers who shifted constantly in response to available food supplies. Areas of greater topographic relief, including foothills along the bases of mountain ranges and isolated uplifts, seem to have been the most favorable for human occupation. Intermontane basins such as the Bighorn Basin in Wyoming were especially important for the development and continuation of these cultural groups (Frison 1973a).

Unfortunately for the archeologist, the Northwestern Plains area could never support forms of political and social organization higher than simple bands. Neither could it support New World crop domestication and agriculture. As a result it lacks the evidence for increasing cultural complexity of the various stages of development found in other areas. Lacking entirely is the development of village life, ceramics (until very late), craft specializations, and other things that provide the archeologist with additional reliable temporal indicators. About the only things that changed through time were projectile point types and styles, and to a lesser extent certain items in tool assemblages. Hence, the dependence on stratigraphy and typology by the archeologist seems justified.

In short, the Paleo-Indian hunting group was about the same size and of the same complexity as the terminal Late Prehistoric period hunting group and was doing about the same thing. Projectile point typology offers the best temporal indicator for many situations where stratigraphic, faunal, or absolute dating evidence is lacking.

Another consideration is site visibility, which is a major problem faced by the High Plains archeologist. Communal animal kills are of high visibility but provide evidence of only a small segment of the total cultural system. Associated butchering, processing, and camping areas are of high visibility but apparently did not preserve well, at least in the Paleo-Indian period. These activity areas are lacking, for example, from the Colby, Horner, and Casper sites and are present but only in a minimal sense at the Agate Basin and Finley sites. (All these sites are discussed in detail later.) Most activities, however, of a small hunting and gathering group were manifestations of activities of short duration. Cultural assemblages were small and little was left behind so that most sites are manifest only by small amounts of debitage, simple tools, and possibly a broken projectile point. Rarely is the faunal evidence in such sites preserved. With this kind of evidence the investigator relies heavily on typology and hopes that there will be occasional large sites with occupations in a well-defined stratigraphic sequence or single occupations with datable materials to serve as a key for the identification of numerous sites of low visibility. We as Plains archeologists have not paid enough attention to sites of low visibility. Until some methodology is developed so that we can detect their presence and understand their purposes, there is little chance of significant breakthroughs in studies of cultural systematics on the Northwestern Plains.

REWORKING THE CHRONOLOGICAL FRAMEWORK

A universally understood and accepted frame of reference within which an archeological material can be placed is absolutely necessary—if the find is to be of value. However, the nature of the data collected so far has not led to the desired degree of agreement. It is unlikely that two or more investigators working in different parts of the Northwestern Plains can at this time integrate their findings and reach agreement on the nature of prehistoric lifeways. Consequently there is no satisfactory frame of reference.

The first serious attempt to establish a historical outline for the Northwestern Plains was made by Mulloy (1958), who proposed an Early Prehistoric period corresponding to the Paleo-Indian period in common usage. The Altithermal period (Antevs 1955) corresponds roughly to what Mulloy called a "gap without evidence" because in the 1950s there was little or no sure evidence for human occupation of the Northwestern Plains during the period, a condition that Mulloy himself said could be due to incomplete knowledge. This creates a problem at present, since the evidence has accumulated.

In Mulloy's scheme the period from the immediate post-Altithermal (about 4500 to 3000 years ago) to the Late Prehistoric period (about 1500 years ago) is called the Middle Prehistoric period, which is itself divided into the Early Middle and Late Middle Prehistoric periods. The dividing line falls at about 2500 years ago and is based mainly on changes in projectile point types. Following this is the Late Prehistoric period, which lasted until historic times.

Mulloy's historical outline has been useful and is still widely referred to, but it has not been unanimously accepted. Wormington and Forbis (1965) attempted to substitute the term *Meso-Indian* for a stage accommodating the cultural events of the Altithermal period and the Middle Prehistoric period, and the term *Neo-Indian* for the Late Prehistoric period. The scheme might be workable but would require a breakdown of the Meso-Indian stage to accommodate the various cultural manifestations known for the time period involved. The most serious problem is that cultural stages are involved and arbitrary time lines are not realistic unless there are concomitant observable cultural changes. Actually this scheme appears to have little superiority over Mulloy's. Reeves

(1970) suggested that the Early Middle Prehistoric period be extended to 7000 years ago. This solution to the problem still requires further breakdown of the period to accommodate data now available for the Altithermal period. All these schemes are based on arbitrary time boundaries and are able to satisfy the requirements of the investigator only up to a certain level of interpretation.

Another approach was suggested but never pursued (Knudson 1970). The proposed model recognized seven "archeological patterns" on the Plains from about 8000 to 1000 years ago based on projectile point typology. This model had promise but could survive only by nurturing it with massive doses of data evaluation, reevaluation, and gathering. Investigators who become deeply involved with a research area over long periods of time are not prone to accepting suggested models such as this one; they usually construct their own. The major significance of Knudson's proposed model lies in its recognition of the inadequacies and limitations of a frame of reference based on arbitrary time boundaries.

Willey (1966) devotes a few pages to the concept of a Plains Archaic period but again an arbitrary time boundary of about 6000 to 2000 years ago is used, which is neither realistic nor useful for the investigator specializing in the Northwestern Plains. Obviously, there is no simple solution to the needs of chronological ordering of the post–Paleo-Indian period on the Northwestern Plains and perhaps it would be wise to await the accumulation of a more reliable data base before such a model is proposed. Certainly the chronology, origins, and the knowledge of the cultural systematics of the Altithermal cultural groups as well as of the foothill-and-mountain-oriented Paleo-Indian cultural groups are still in their infancy. On the other hand, some kind of temporary, trial, and arbitrary chronological model—one that can be later discarded with no feelings of remorse—is needed purely for greater ease of reference.

One temporary solution is to retain the original scheme of Mulloy and simply refer to the fast-accumulating body of Altithermal period material as "the Altithermal cultures." However, *Altithermal* is a geological and climatic designation. The term *Archaic* has been somewhat less than satisfactory; still it is firmly entrenched in archeology even in many parts of the Great Plains. On the other hand, the area described here as the Northwestern Plains is such that the concept of an Archaic stage (Willey and Phillips 1958:107) may be acceptable. The area is not "plains" in the same sense that the Northern Plains and the Central Plains are considered plains. Bison were present on the Northwestern Plains throughout the Holocene, but their distribution and density varied. There were a few local spots rich enough in terms of plant and animal resources to have supported a true hunting economy comparable to the Northern Plains but many more spots were relatively marginal and required close attention to gathered resources. As a result the prehistoric economic adaptations of the Northwestern Plains fit into an Archaic way of life perhaps more so than that of plains hunters who are traditionally regarded as more oriented economically toward procurement of large game animals.

If an Archaic stage concept is applied to the Northwestern Plains, rigid time boundaries will someday have to be discarded. The foothill-and-mountain-oriented groups were living an Archaic way of life during late Paleo-Indian times as were many other cultural groups up until historic times. So, for the sake of convenience of reference at this time, the Altithermal period cultural groups in this book are subsequently referred to as *Early Plains Archaic*; Mulloy's Early Middle Prehistoric period is referred to as the *Middle Plains Archaic*; and Mulloy's Late Middle Prehistoric period is the *Late Plains Archaic*.

The response to this scheme will probably be of about the same negative nature and magnitude as the response to Malouf's (1958) concept and usage of the term *foragers* for the Plains peoples. The term seems to have acquired the connotation that these cultural groups were somehow inferior. The truth of the matter is that foragers or hunters and gatherers or whatever they are to be named were probably more successful and viable than were the true hunters who were specialized to exploit a single resource. Much of the Northwestern Plains as described here provided an economic base more favorable for foraging or hunting and gathering than did the Northern or Central Plains. These kinds of ecological differences must be considered in constructing frames of reference even though there were apparently no cultural barriers between the major areas of the Plains.

Ecological boundaries such as that between Plains and foothills are more easily detected than cultural boundaries on the Northwestern Plains. Ecological boundaries did sometimes serve as cultural barriers, depending upon distributions of economic resources. On the other hand, this distribution changed through time as climatic conditions changed. Also, changes in human technology such as the development of the flat grinding slab and mano sometimes brought about changes in the nature of ecological barriers.

THE CULTURAL CHRONOLOGY

The Paleo-Indian Period

Radiocarbon dates from Clovis and Folsom sites are listed in Table 2.1. Later Paleo-Indian radiocarbon dates are found in Table 2.2. In addition, there are several archeological sites having long, stratified sequences that have been dated; these are presented in separate tables. These sites include Medicine Lodge Creek (Table 2.3); Mummy Cave (Table 2.4); Hell Gap and Patten Creek (Table 2.5); Bighorn Canyon sites (Table 2.6); Southsider Cave (Table 2.7); and the Myers–Hindman site (Table 2.8). Paleo-Indian site locations are shown in Figure 2.1.

There does not appear to be a mutual agreement between all concerned as to the beginning of the Holocene. If we accept the postglacial period as a beginning date, we must consider the immediate pre-Holocene also in our cultural chronology of the area.

TABLE 2.1
Radiocarbon Dates for Clovis and Folsom Sites

Lab. No.	Date	Cultural affiliation	Site
I–472	10,375 ± 700 (8425 B.C.)	Folsom	Brewster, Wyo.
RL–374	10,700 ± 670 (8750 B.C.)	Folsom	Hanson, Wyo.
RL–558	10,080 ± 330 (8130 B.C.)	Folsom	Hanson, Wyo.
I–141	10,850 ± 550 (8900 B.C.)	Folsom	Lindenmeier, Colo.
A–366	10,550 ± 350 (8600 B.C.)	Undetermined	Rawhide Butte Mammoth, Wyo.
I–622	11,200 ± 500 (9250 B.C.)	Clovis	Dent, Colo.
RL–392	11,200 ± 220 (9250 B.C.)	Clovis	Colby, Wyo.
SMU–254	10,548 ± 141 (8598 B.C.)	Clovis	Colby, Wyo.
I–499	11,280 ± 350 (9330 B.C.)	Possible Clovis	Union Pacific Mammoth, Wyo.
WSU–652	10,700 ± 290 (8760 B.C.)	Possible Clovis	Lindsay Mammoth, Mont.[a]
I–9220	10,980 ± 225 (9030 B.C.)	Possible Clovis	Lindsay Mammoth, Mont.[a]
S–918	11,925 ± 350 (9975 B.C.)	Possible Clovis	Lindsay Mammoth, Mont.[a]

[a] Lindsay mammoth dates courtesy of Leslie B. Davis, personal communication 1976.

TABLE 2.2
Paleo-Indian Radiocarbon Dates

Lab. No.	Date	Cultural complex	Site
A–484	7800 ± 110 (5850 B.C.)	Pryor Stemmed	48J0303, Wyo.
WSU–670	7880 ± 430 (5930 B.C.)	Lusk	Betty Greene, Wyo.
M–304	7900 ± 400 (5950 B.C.)	James Allen	James Allen, Wyo.
RL–391	8140 ± 150 (6190 B.C.)	Pryor Stemmed (possible variant)	Paint Rock V, Wyo.
RL–381	8340 ± 160 (6390 B.C.)	Pryor Stemmed (possible variant)	Paint Rock V, Wyo.
RL–100	8360 ± 160 (6410 B.C.)	Pryor Stemmed	Schiffer Cave, Wyo.
RL–99	8500 ± 160 (6550 B.C.)	Pryor Stemmed	Schiffer Cave, Wyo.
SI–74	7880 ± 1300 (5930 B.C.)	Cody	Horner, Wyo.
UCLA–697A	8750 ± 120 (6800 B.C.)	Cody	Horner, Wyo.
UCLA–697B	8840 ± 120 (6890 B.C.)	Cody	Horner, Wyo.
RL–574	8950 ± 220 (7000 B.C.)	Cody	Finley, Wyo.
SMU–250	9026 ± 118 (7076 B.C.)	Cody	Finley, Wyo.
C–454	7715 ± 740 (5765 B.C.)	No known association	Ray Long, S. Dak.
M–370	9380 ± 500 (7430 B.C.)	Angostura	Ray Long, S. Dak.
GX–0530	9700 ± 250 (7750 B.C.)	Paleo-Indian burial	Gordon Creek, Colo.
GX–354	9695 ± 195 (7745 B.C.)	Plano	Pine Spring, Wyo.
GX–355	11,830 ± 410 (9880 B.C.)[a]	Agate Basin Variant	Pine Spring, Wyo.
SMU–52	8990 ± 190 (7040 B.C.)	Alberta	Hudson–Meng, Nebr.[b]
SMU–102	9380 ± 100 (7430 B.C.)	Alberta	Hudson–Meng, Nebr.[b]
SMU–224	9820 ± 160 (7870 B.C.)	Alberta	Hudson–Meng, Nebr.[b]
A–372	9600 ± 230 (7650 B.C.)	Hell Gap	Sister's Hill, Wyo.
I–221	9650 ± 250 (7700 B.C.)	Hell Gap	Sister's Hill, Wyo.
RL–125	9830 ± 350 (7880 B.C.)	Hell Gap	Casper, Wyo.
RL–208	10,060 ± 170 (8110 B.C.)	Hell Gap	Casper, Wyo.
RL–640	8790 ± 210 (6840 B.C.)	Parallel-Oblique Flaked	Little Canyon Creek Cave
RL–641	10,170 ± 250 (8220 B.C.)	Unknown	Little Canyon Creek Cave
O–1252	9350 ± 450 (7400 B.C.)	Agate Basin	Brewster (Agate Basin site area, upper Agate Basin), Wyo.
M–1131	9990 ± 225 (8040 B.C.)	Agate Basin	Brewster (Agate Basin site area, middle Agate Basin), Wyo.
RL–557	10,430 ± 570 (8480 B.C.)	Agate Basin	Agate Basin main bone level, Wyo.

[a] Date rejected.

[b] Radiocarbon dates for the Hudson–Meng site courtesy of Larry Agenbroad, personal communication 1976.

TABLE 2.3
Radiocarbon Dates from the Medicine Lodge Creek Site

Lab. No.	Date	Cultural affiliation
RL–378	230 ± 80 (A.D. 1720)	Late Prehistoric (Crow)
RL–375	960 ± 90 (A.D. 990)	Late Prehistoric
RL–376	1360 ± 100 (A.D. 590)	Late Prehistoric
RL–95	1560 ± 130 A.D. 390)	Late Plains Archaic
RL–440	1790 ± 160 (A.D. 160)	Late Plains Archaic
RL–96	3020 ± 140 (1070 B.C.)	Late Plains Archaic (Pelican Lake)
RL–559	3110 ± 170 (1160 B.C.)	Late Plains Archaic (Pelican Lake)
RL–97	3740 ± 150 (1790 B.C.)	Middle Plains Archaic
RL–442	3750 ± 260 (1800 B.C.)	Middle Plains Archaic
RL–98	3980 ± 160 (2030 B.C.)	Middle Plains Archaic (McKean)
RL–438	4050 ± 150 (2100 B.C.)	Middle Plains Archaic (McKean)
RL–395	8050 ± 240 (6100 B.C.)	Stemmed projectile point
RL–380	8160 ± 220 (6210 B.C.)	Pryor Stemmed projectile points
RL–151	8340 ± 220 (6390 B.C.)	Pryor Stemmed and lanceolate projectile points
RL–152	8320 ± 220 (6370 B.C.)	Lanceolate projectile points (possible Lovell Constricted)
RL–388	8520 ± 230 (6570 B.C.)	Lanceolate projectile points
RL–384	8010 ± 340 (6060 B.C.)	Lanceolate projectile points
RL–384[a]	8570 ± 230 (6620 B.C.)	Lanceolate projectile points
RL–446	8830 ± 470 (6880 B.C.)	Cody Complex tools
RL–150	9360 ± 380 (7410 B.C.)	Split-based projectile points
RL–450	9510 ± 260 (7560 B.C.)	Below split-based projectile points
RL–393	9590 ± 180 (7640 B.C.)	Stemmed, rounded-base projectile point
RI-153	9620 ± 260 (7670 B.C.)	Extensive bone midden, flakes
RL-382	9940 ± 350 (7990 B.C.)	Grinding stones, faunal materials
RL–382[a]	9030 ± 260 (7080 B.C.)	Grinding stones, faunal materials
RL–154	9700 ± 620 (7750 B.C.)	Projectile point possible Plainview

[a] RL–382[a] and RL–384[a] are both dates obtained by recovery of fine charcoal particles from RL–382 and RL–384 respectively.

TABLE 2.4
Radiocarbon Dates from Mummy Cave[a]

Lab. No.	Date		Cultural level	Cultural affiliation
I–1074	370 ± 90	(A.D. 1580)	Layer 38	Late Prehistoric
I–1009	1230 ± 110	(A.D. 720)	Layer 36	Late Prehistoric
I–1075	2050 ± 150	(100 B.C.)	Layer 34	Late Plains Archaic
I–1427	2820 ± 135	(870 B.C.)	Layer 32	Late Plains Archaic
I–1428	4420 ± 150	(2470 B.C.)	Layer 30	Middle Plains Archaic (McKean)
I–1429	5255 ± 140	(3305 B.C.)	Layer 28	Early Plains Archaic
I–1466	5390 ± 140	(3440 B.C.)	Layer 24	Early Plains Archaic
I–1585	5610 ± 280	(3660 B.C.)	Layer 21	Early Plains Archaic
I–2350	5800 ± 120	(3850 B.C.)	Layer 20	Early Plains Archaic
I–1587	7140 ± 170	(5190 B.C.)	Layer 18	Early Plains Archaic
I–2358	6780 ± 130	(4830 B.C.)	Layer 17	Early Plains Archaic
I–1588	7630 ± 170	(5680 B.C.)	Layer 16	Early Plains Archaic
I–1589	7970 ± 210	(6020 B.C.)	Layer 14	Lanceolate Paleo-Indian projectile points
I–2354	8100 ± 130	(6150 B.C.)	Layer 12	Lanceolate Paleo-Indian projectile points
I–2353	8740 ± 140	(6790 B.C.)	Layer 10	Lanceolate Paleo-Indian projectile points
I–2355	8430 ± 140	(6480 B.C.)	Layer 8	Lanceolate Paleo-Indian projectile points
I–2356	9230 ± 150	(7280 B.C.)	Layer 4	Lanceolate Paleo-Indian projectile points

[a] Data from Husted and Edgar n.d.

TABLE 2.5
Radiocarbon Dates from the Hell Gap and Patten Creek Sites[a]

Lab. No.	Date		Cultural affiliation
A–432	1000 ± 160	(A.D. 950)	Late Prehistoric fire pit
A–497	1880 ± 180	(A.D. 70)	Fireplace (Patten Creek)
A–706	2990 ± 140	(1040 B.C.)	Charcoal from fire pit (Patten Creek)
A–563	3430 ± 200	(1480 B.C.)	Buried fireplace
A–498	5830 ± 230	(3790 B.C.)	Altithermal soil
A–707	8590 ± 350	(6640 B.C.)	Alberta
I–245	8600 ± 600	(6650 B.C.)	Scottsbluff
A–501	8690 ± 380	(6740 B.C.)	Fredrick
A–499	10,090 ± 200	(8140 B.C.)	Midland
A–500	10,240 ± 300	(8290 B.C.)	Hell Gap and Alberta
A–502	10,290 ± 500	(8340 B.C.)	Midland
A–504	10,690 ± 500	(8740 B.C.)	Unidentified projectile point
I–167	10,850 ± 500	(8900 B.C.)	Agate Basin level (possible)
A–503	10,930 ± 200	(8980 B.C.)	Base of Unit E
A–431	13,060 ± 600	(11,110 B.C.)	Predates occupation of site

[a] Data from Haynes 1967; Haynes *et al.* 1967, Damon *et al.* 1964.

TABLE 2.6
Radiocarbon Dates from the Big Horn Canyon Sites[a]

Lab. No.	Date		Site	Cultural affiliation
SI–99	1050 ± 70	(A.D. 900)	Mangus 24CB221	Late Prehistoric (Avonlea-like)
SI–100	1070 ± 70	(A.D. 880)	Mangus 24CB221	Late Prehistoric (Avonlea-like)
SI–103	1280 ± 55	(A.D. 670)	Bill Green 24BH253	Late Prehistoric (Avonlea-like)
I–690	1310 ± 100	(A.D. 640)	Sorenson 24CB202	Late Prehistoric
SI–238	1510 ± 200	(A.D. 440)	Bottleneck 48BH206	Late Plains Archaic
SI–239	3820 ± 200	(1870 B.C.)	Bottleneck 48BH206	Middle Plains Archaic (McKean)
I–691	4900 ± 250	(2950 B.C.)	Sorenson 24CB202	Middle Plains Archaic (McKean)
I–692	5475 ± 190	(3525 B.C.)	Sorenson 24CB202	Early Plains Archaic
I–689	7560 ± 250	(5610 B.C.)	Sorenson 24CB202	Pryor Stemmed
I–612	7800 ± 250	(5850 B.C.)	Sorenson 24CB202	Lovell Constricted
SI–308	7960 ± 150	(6010 B.C.)	Sorenson 24CB202	Paleo-Indian (Agate Basin-like, Scottsbluff-like, and Alberta-like)
SI–241	8040 ± 200	(6090 B.C.)	Bottleneck 48BH206	Pryor Stemmed
SI–240	8160 ± 180	(6210 B.C.)	Bottleneck 48BH206	Pryor Stemmed
SI–236	8210 ± 200	(6260 B.C.)	Bottleneck 48BH206	Paleo-Indian (unidentified)
SI–237	8270 ± 180	(6320 B.C.)	Bottleneck 48BH206	Lovell Constricted and unidentified Paleo-Indian
SI–101	8600 ± 100	(6650 B.C.)	Mangus 24CB221	Lanceolate Paleo-Indian, Agate Basin-like and Scottsbluff-like
SI–98	8690 ± 100	(6740 B.C.)	Mangus 24CB221	Lanceolate Paleo-Indian, Agate Basin-like and Scottsbluff-like

[a] Data from Husted 1969.

TABLE 2.7
Southsider Cave Radiocarbon Dates

Lab. No.	Date		Cultural affiliation
RL–673	1570 ± 110	(A.D. 380)	Late Plains Archaic
RL–674	1680 ± 110	(A.D. 270)	No diagnostic cultural material
RL–668	3900 ± 140	(1950 B.C.)	Middle Plains Archaic, McKean
RL–672	4170 ± 150	(2220 B.C.)	Middle Plains Archaic, McKean
RL–670	5420 ± 160	(3470 B.C.)	Early Plains Archaic
RL–671	5570 ± 160	(3620 B.C.)	Early Plains Archaic
RL–667	5700 ± 160	(3750 B.C.)	Early Plains Archaic
RL–669	7650 ± 200	(5700 B.C.)	Early Plains Archaic
RL–666	8500 ± 210	(6550 B.C.)	Lanceolate Paleo-Indian projectile point
RL–665	9360 ± 230	(7410 B.C.)	Paleo-Indian, tools and flakes only

TABLE 2.8
Radiocarbon Dates From the Myers–Hindman Site[a]

Lab. No.	Date		Cultural relationship
GaK 2631	790 ± 90	(A.D. 1160)	Late Prehistoric
GaK 2633	1470 ± 70	(A.D. 480)	Late Plains Archaic
GaK 2628	2300 ± 120	(350 B.C.)	Late Plains Archaic
GaK 2630	3150 ± 110	(1200 B.C.)	Corner-notched and McKean (mixed Middle and Late Plains Archaic)
GaK 2629	3530 ± 110	(1580 B.C.)	Corner-notched and McKean (mixed Middle and Late Plains Archaic)
GX–1490	4680 ± 220	(2730 B.C.)	Bitterroot (Early Plains Archaic?)
GaK 2632	5590 ± 150	(3640 B.C.)	Bitterroot (Early Plains Archaic)
GaK 2624	8540 ± 190	(6590 B.C.)	Paleo-Indian lanceolate
GaK 2627	9400 ± 200	(7450 B.C.)	Paleo-Indian, lanceolate, stemmed and notched points

[a] Data from Lahren 1976.

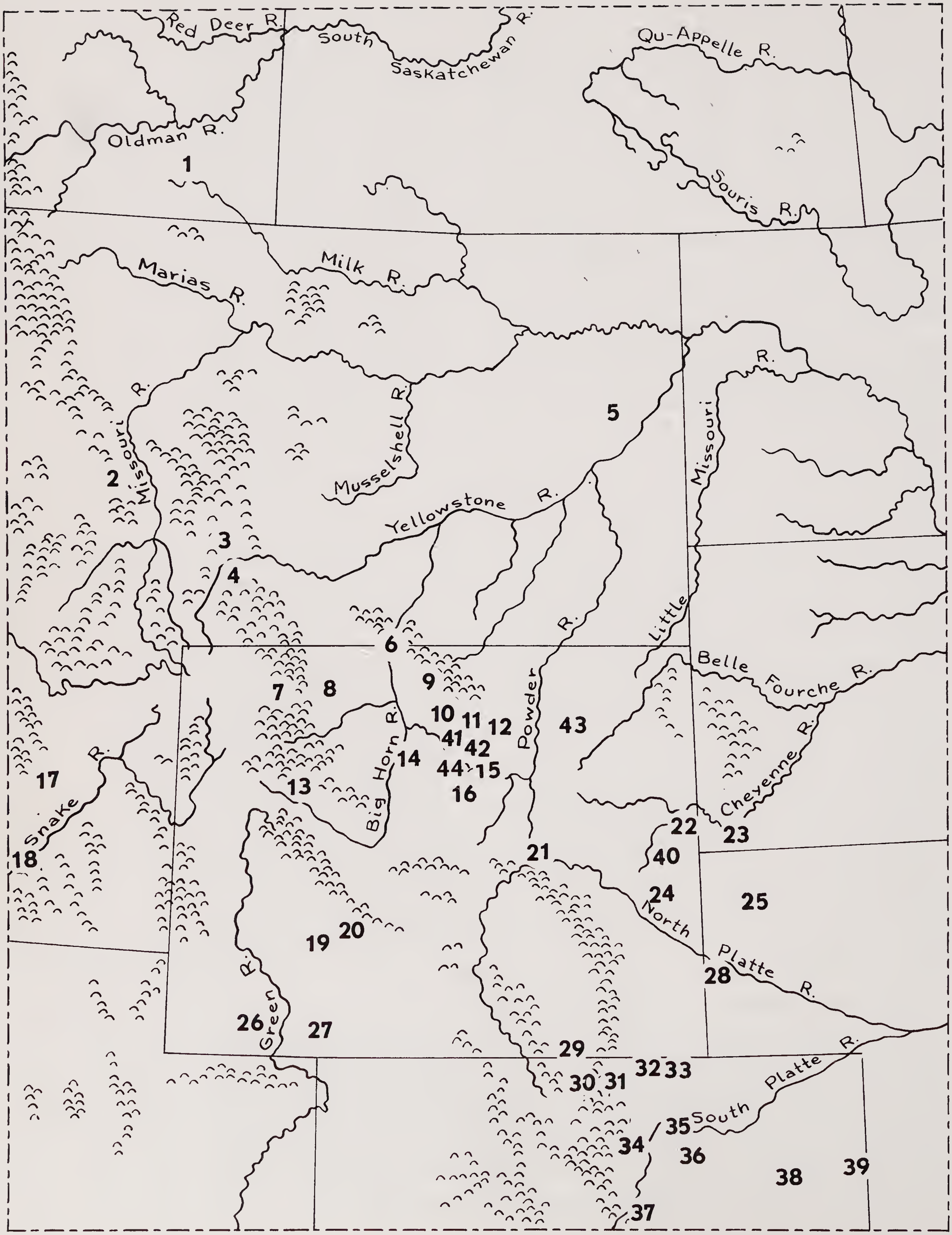
At present there are no known uninterrupted stratigraphic sequences on the Northwestern Plains from immediate pre-Clovis to Clovis as it is present in areas further south such as the San Pedro Valley in Arizona (Haynes 1970). At the Colby mammoth site (see p. 86) the culture-bearing deposits are in an arroyo cut directly into bedrock deposits. At the Union Pacific Mammoth site (McGrew 1961), the deposits below those with the mammoth and associated fauna have not been tested but are apparently of this same bedrock nature. Several cave sites, including Little Box Elder Cave in Converse County, Wyoming (Anderson 1968), Bell Cave in Albany County, Wyoming (Zeimens and Walker 1974), and Horned Owl Cave in Albany County, Wyoming (Guilday *et al.* 1967), have all produced late Pleistocene fauna but no dates or cultural material to suggest immediate pre-Clovis occupation. An animal trap in extreme northern Wyoming appears to have faunal evidence of the immediate pre-Clovis period but there is no evidence of human association (Gilbert 1975). Jaguar Cave in the Upper Birch Creek Valley in east-central Idaho has a good record of sediments and faunas that lived in that area from about 15,000 to 9000 years ago (Kurten and Anderson 1972; Sadek-Kooros 1972) and a pre-Clovis human use of the cave is also suggested (Dort 1975). Early dates from Wilson Butte Cave further south along the Snake River in south-central Idaho may also be evidence of a pre-Clovis habitation (Gruhn 1965). These two caves are somewhat west of and in a different area altogether than the Northwestern Plains and are suggestive but not indicative of pre-Clovis occupation further to the east. What little evidence is known for the immediate pre-Clovis period of the Northwestern Plains indicates that a late Pleistocene, pre-Clovis fauna was present but human association remains to be proven.

At Little Canyon Creek Cave (48WA323) in the southern Bighorn Basin of Wyoming (unpublished) the author recently (1977) recovered cultural materials in context with a small amount of faunal material including remains of a *Symbos*. The cultural stratum lies unconformably below two other cultural levels radiocarbon dated at just under 9,000 and just over 10,000 years ago (see Table 2.2). Only the youngest produced cultural diagnostics. The oldest level could be of pre-Clovis age based on deposition rates determined from the dated levels.

Strongly indicative of pre-Clovis cultural activity are what appear to be numbers of bone tools in context with extinct faunal remains underlying a Clovis level in old pond deposits on the plains of northeastern Colorado (Dennis Stanford, personal communication 1976, 1977). Absolute proof, however, requires further investigation.

The Clovis Complex

Clovis is widespread on the Northwestern Plains. This conclusion is based on the diagnostic projectile point occurrence in at least three sites. A Clovis point was found at the Casper Hell Gap site (Frison 1974b:74). However the site itself was not a Clovis site and the presence of a Clovis point remains unexplained. Occasional surface finds are known for many areas including the Red Desert, Upper Green River Basin, and Bighorn Mountain areas of Wyoming and the drainages of the Yellowstone River in Montana.


Red Deer R.
South Saskatchewan R.
Qu-Appelle R.
Oldman R.
Souris R.
1
Milk R.
Marias R.
Missouri R.
Musselshell R.
5
Missouri R.
2
Yellowstone R.
3
4
Little
6
Belle Fourche R.
7
8
9
10
11
12
Powder R.
43
41
42
Big Horn R.
14
44
15
Snake R.
17
13
16
Cheyenne R.
22
23
18
21
40
24
25
North Platte R.
19
20
28
Green R.
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South Platte R.
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The Anzick site, located on a drainage of a Yellowstone River tributary near Wilsall, Montana, was apparently a burial of the Clovis period. The site was discovered through earth-moving activity and was unfortunately badly disturbed. The site contained parts of two red-ocher-covered subadults and over 100 stone and bone artifacts. Projectile points (see Chapter 5, Figure 5.14a) appear similar to those from the Simon site in Idaho (Butler 1963), and some bifaces may be projectile point preforms. A number of bifaces and carved bone objects, possibly foreshafts, were also found. A method of use for these has been proposed (Lahren and Bonnichsen 1974).

Dated Clovis sites include the Colby site in the Big Horn Basin and the Union Pacific Mammoth site. Some question remains as to whether the latter is a Clovis site (Haynes 1970:79) because of the lack of Clovis projectile points and the questionable context of some other artifact material recovered. Another possible dated mammoth kill site (also questioned because of a lack of diagnostic artifacts) is the Lindsay Mammoth site in east-central Montana; human assocation is claimed mainly on the basis of bone distribution and the presence of several angular sandstone blocks that are suggested to be intrusive since their source would have to have been some distance from the site (Davis 1971).

Projectile points from the Colby site (see Chapter 3, Figures 3.3 and 3.4) will be difficult for some to accept as true Clovis. They are, however, fluted; the date is within the range of Clovis; and they were somehow involved with a group procuring and butchering mammoths. The fact that the Colby site points are less typical raises the question of geographical, temporal, or functional variants but the question cannot be answered at this time. In this context, it is worthwhile to note that one of the Colby site projectile points is not too much unlike the Dent site projectile points (see Figgins 1933; Wormington 1957:43–45) in north-central Colorado, a Clovis mammoth kill site dated at 11,200 B.P. ± 500 (I–622).

FIGURE 2.1. Archeological sites of the Paleo-Indian period. 1: Fletcher (Forbis 1968); 2: MacHaffie 24JF4 (Forbis and Sperry 1952); 3: Anzick 24PA506 (Lahren and Bonnichsen 1974); 4: Myers–Hindman 24PA504 (Lahren 1976); 5: Lindsay Mammoth 24DW501 (Davis 1971); 6: Bighorn Canyon Caves 24CB202, 24CB221, 48BH206 (Husted 1969); 7: Mummy Cave 48PA201 (Wedel *et al.* 1968); 8: Horner 48PA29 (Jepsen 1953); 9: Hanson 48BH329 (this volume); 10: Medicine Lodge Creek 48BH499 (Frison 1976a); 11: Paint Rock V 48BH349 (Frison 1976a); 12: Sister's Hill 48JO314 (Agogino and Galloway 1965); 13: Lookingbill 48FR308 (Frison 1976a); 14: Colby 48WA322 (Frison 1976c; this volume); 15: Schiffer Cave 48JO319 (Frison 1973a) 16: 48JO303 (Haynes *et al.* 1966); 17: Wasden (Butler 1968); 18: Haskett (Butler 1965); 19: Finley 48SW5 (Moss *et al.* 1951); 20: Morgan 48SW773 (unpublished); 21: Casper 48NA304 (Frison 1974b); 22: Agate Basin 48NO201 (Roberts 1951, 1961; this volume); 23: Ray Long 39FA65 (Hughes 1949); 24: Hell Gap 48GO305 (Irwin-Williams *et al.* 1973); 25: Hudson–Meng 25SX115 (Agenbroad 1973, 1974a, 1974b); 26: Pine Spring 48SW101 (Sharrock 1966); 27: Mud Springs 48SW774 (unpublished); 28: Scottsbluff Bison Quarry (Barbour and Schultz 1932); 29: James Allen 48AB4 (Mulloy 1959); 30: Gordon Creek Burial 5LR99 (Breternitz *et al.* 1971); 31: Johnson 5LR26 (Galloway and Agogino 1961); 32: Lindenmeier 5LR13 (Roberts 1935, 1936); 33: Wilbur–Thomas 5WL45 (Breternitz 1971); 34: Dent 5WL269 (Figgins 1933); 35: Jurgens 5WL53 (Wheat 1974, 1975); 36: Frazier 5WL268 (Wormington, personal communication 1976); 37: Lamb Springs 5AH125 (Wedel 1963); 38: Claypool 5WN18 (Dick and Mountain 1960); 39: Jones–Miller 5YM8 (Stanford 1974; personal communication 1975); 40: Betty Greene 48NO203 (Greene 1967); 41: Laddie Creek 48BH345 (this volume); 42: Southsider Cave 48BH364 (this volume); 43: Carter–Kerr McGee 48CA12 (this volume); 44: Little Canyon Creek Cave 48WA323 (this volume).

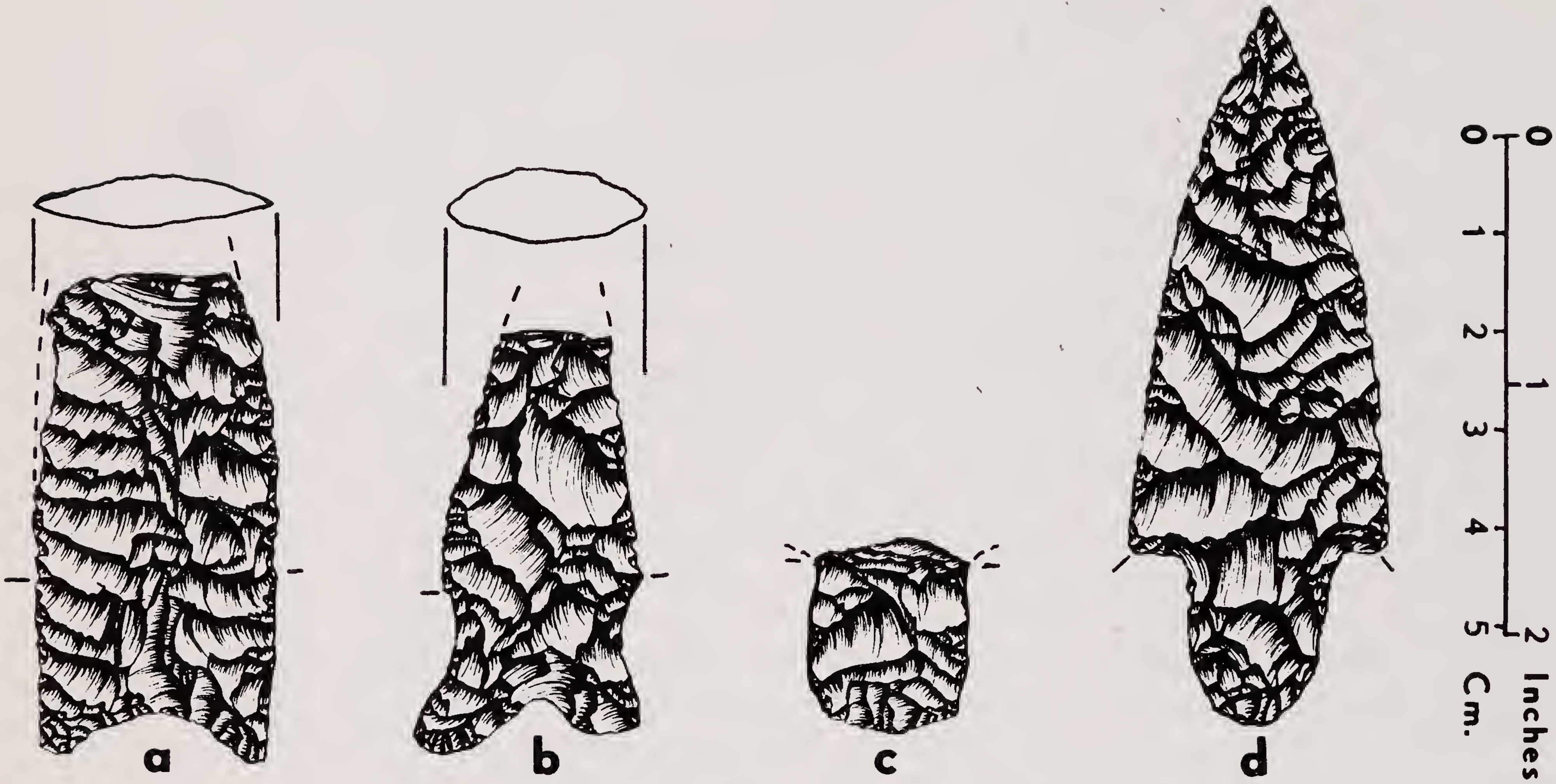
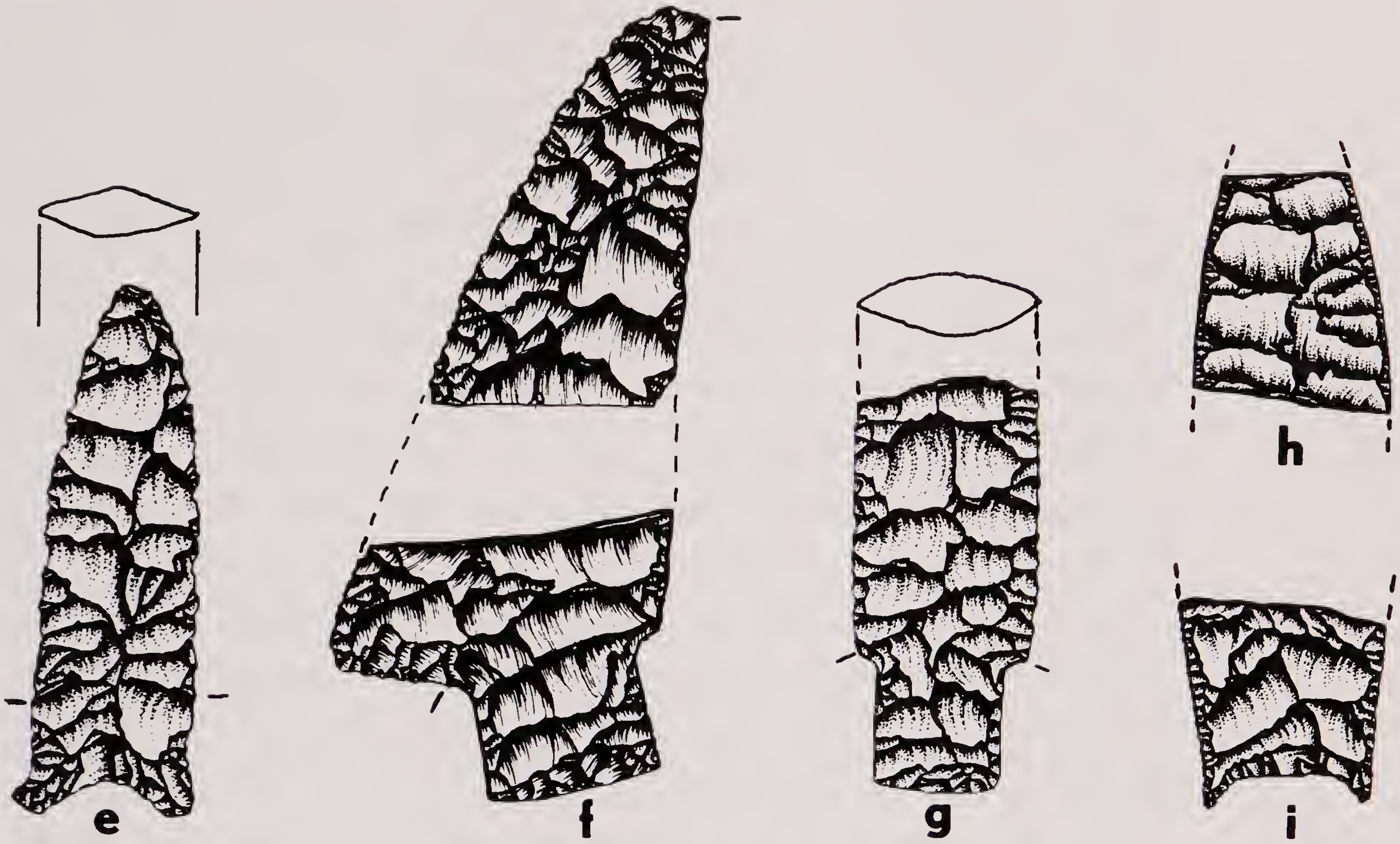


FIGURE 2.2. Projectile points (a–c, e, g) and a Cody knife (f) from the Medicine Lodge Creek site. Surface find (d) is regarded as the same type as (c). Probable Midland projectile points from northern Wyoming (h, i).

Folsom

Folsom follows Clovis on the Northwestern Plains with no radiocarbon-dated intermediate forms. The mammoths disappear and there is an apparent time gap of several hundred years. The gap in question may be filled by what is referred to as the Goshen Complex at the Hell Gap site in southeastern Wyoming. Designated as post-Clovis and pre-Folsom but with no carbon dates, the Goshen Complex has a suggested time range from 11,000 to 10,800 years ago (Irwin-Williams *et al.* 1973). In addition, there are many fluted points found regularly that are difficult to label as either Folsom or Clovis. For example, an area of about half a square mile on the western side of the Bighorn Mountains near the head of two streams at an elevation of 8500 feet has been especially prolific. I have substantiated 17 fluted points from here that might technologically fit between Clovis and Folsom, but a stratigraphic, datable context remains to be located. Other similar projectile point finds are more widely scattered.

Folsom points were rare at the Hell Gap site; their suggested time range at the site is between 10,800 and 10,600 years ago (Irwin-Williams *et al.* 1973). Other Folsom sites are known that are radiocarbon dated. The Lindenmeier site



in extreme northern Colorado (Roberts 1935, 1936), the Brewster site at the Agate Basin site locality in eastern Wyoming (Agogino 1972), and the Hanson site in extreme northern Wyoming (see p. 115) are radiocarbon dated. Undated Folsom sites include the MacHaffie site in northern Montana (Forbis and Sperry 1952) and the Turk site atop the southern Bighorn Mountains, which is a surface site that has yielded evidence of Folsom projectile point manufacture. Two other undated sites in the Red Desert of Wyoming are the Morgan site north of Rock Springs and the Mud Springs site south of Rock Springs. The stratified Carter-Kerr McGee site near Gillette, Wyoming contains a Folsom level. The cultural assemblage is not yet analyzed.

At the Hell Gap site (Irwin-Williams *et al.* 1973), the investigators felt there was a separation between Midland and Folsom but with some overlap. Midland dates are suggested to be between 10,700 and 10,400 years ago. Midland-type projectile points occurred in the same cultural level with Folsom at the Hanson site and appear to be Folsom points lacking only the fluting stage of manufacture. The Folsom–Midland "problem" is obviously not yet solved. On the other hand, surface finds regularly occur that could represent a true Midland Complex (for example Figure 2.2 h, i).

Agate Basin

Agate Basin dates at the Hell Gap site fall between 10,500 and 10,000 years ago, according to the investigators (Irwin-Williams *et al.* 1973). Of all

Paleo-Indian complexes at the site, Agate Basin was the best represented. Dates are known for the Agate Basin levels at the Brewster site (Agate Basin site locality; see Table 2.2). However, present evidence indicates that these dates are apparently too late, unless Agate Basin continued after Hell Gap appeared. Another Agate Basin site date on charcoal from the bone level is now available (10,430 ± 570 years ago RL–557) since a reinvestigation of the site has been carried out over the last 4 years (see p. 150). Agate Basin should date over 10,000 years ago on the basis of dates now available on the Hell Gap cultural complex, which followed Agate Basin. There are later manifestations that resemble Agate Basin at least in Projectile point form, however, and this has led to unfortunate designations such as *Agate Basin-like* in describing these. A mixed Agate Basin-Hell Gap level is present at the Carter-Kerr McGee site near Gillette, Wyoming above the Folsom level and separated from it by a sterile level.

There are a number of as yet poorly known Paleo-Indian projectile point types present in the Green River Basin as well as the better known Cody Complex materials such as were found at the Finley site. Samples of this material appeared at the stratified Pine Spring site (Sharrock 1966) and a wide variety of projectile point styles were recovered from Occupations 1 and 2 at the site. Some of these points appear similar to those from dated sequences at Mummy Cave, Medicine Lodge Creek, and Bighorn Canyon. Two bone collagen dates were recovered from Occupation 1 (GX–354; GX–355) but the oldest is considered unreliable by the investigator, who believes that the projectile points associated are variants of Agate Basin. A partial bison skeleton was found in Occupation 1 with a knife in association but no analysis of the bison bone was included in the report. Occupation 1 at Pine Spring needs to be reevaluated to determine whether it is actually part of the true Agate Basin Complex.

Occupation 2 at the Pine Spring site was separated from Occupation 1 by a layer of sterile soil from 6 to 18 inches thick. Occupation 2 was apparently badly mixed, with both Paleo-Indian and Archaic materials present. Cody Complex projectile points, a number of other Paleo-Indian lanceolate point types along with types were recovered in Occupation 2. A bone sample yielded a radiocarbon date of 3630 B.P. ± 80 (GX–0356), which if correct indicates that it must have dated a Middle Plains Archaic component rather than a Paleo-Indian one. Stratified sites in Upper Green River Basin are rare and the Pine Spring site needs to be reinvestigated in an attempt to define the age and relationships of all the cultural components reported at the site.

Hell Gap

A number of Hell Gap radiocarbon dates are available. None are from the Hell Gap level at the Hell Gap site but the investigators (Irwin-Williams *et al.* 1973) claim a date of about 10,300 years ago below the Hell Gap level. Sister's Hill (Agogino and Galloway 1965), a Hell Gap site in north-central Wyoming, yielded two dates (A–372; I–221). One is from channel fill overlying the occupational levels, and the other is from a composite sample taken from three occupational levels. Two dates were obtained from the Casper site (Frison 1974b); RL–125 is from charcoal and RL–208 is from bone. Hell Gap surface finds are made regularly. The largest Hell Gap bison kill or butchering site known to date is near Wray, Colorado, but no radiocarbon dates are yet available (Stanford 1974).

Sometimes mistaken for Hell Gap in western Wyoming is a projectile point type known as Haskett from a site in southern Idaho (Butler 1965). In outline form Haskett points sometimes resemble both Agate Basin and Hell Gap, but flaking technologies are different. Haskett points are found in northwestern Wyoming but to date only on the surface. Butler ventured a possible date for them between 6500 and 5000 B.C. If Butler's dating is correct, Haskett points would be considerably later than either Agate Basin or Hell Gap.

From about 10,000 years ago, the chronological picture is more difficult to follow. Apparently there were concurrent Paleo-Indian occupations, some of which seem to have been more oriented toward an open plains, part-time bison hunting way of life whereas others seem to have favored an existence more strongly oriented toward hunting and gathering in foothill and mountain slope areas. The latter are more Archaic in nature. Two deep, stratified sites, Mummy Cave (Wedel *et al.* 1968) and Medicine Lodge Creek (Frison 1976a; Frison and Wilson 1975) along with several cave sites in Bighorn Canyon in Wyoming and Montana (Husted 1969) and in the southern Bighorn Mountains (Frison 1973a) have helped to clarify somewhat the foothill-and-mountain-oriented groups. The stratified Hell Gap site (Irwin-Williams *et al.* 1973) and a number of single-component sites have aided in establishing the chronology of what many consider to be the big-game-hunting groups.

Alberta

The Alberta level at the Hell Gap site was not dated but the investigators suggest it would have occurred between 9500 and 9000 years ago, based on a date of around 8600 years ago obtained from above the Alberta level (Irwin-Williams *et al.* 1973). Probably the most reliable date on Alberta is one from the Hudson–Meng bison kill site in the northwest corner of Nebraska (Agenbroad, personal communication 1976). There are three radiocarbon dates on the site but the investigator accepts one on charcoal (SMU–224) as probably the most acceptable. Several projectile points (see Chapter 5, Figure 5.19a, b) were recovered at the site. Others have appeared as surface finds in the Bighorn Mountains but none of these was in datable context. A typical Alberta point made of a diagnostic local chart was found on a transmission line survey in the Green River Basin close to Fontenelle Dam in western Wyoming. However, no evidence of the Alberta Complex appeared at the Pine Spring site a short distance further south (Sharrock 1966).

Cody Complex

At the Hell Gap site, a single radiocarbon date for the Cody Complex is given as 8650 B.P. (Irwin-Williams *et al.* 1973). The investigators suggest that the complex lasted from about 8800 to 8400 B.P. The Horner site near Cody, Wyoming (Jepsen 1953) from which the term *Cody Complex* was derived and was the first major discovery of cultural materials of this nature that has produced several radiocarbon dates. Of these C–320 and C–795 are not considered reliable and SI–74 is questionable. The oldest of the dates (UCLA–697A and UCLA–697B) appear to be the most acceptable. Two radiocarbon dates are now available for the Finley site (RL–574; SMU–250), which is being reinvestigated. Both the Horner site and the Finley site produced projectile points (see Chapter 5) of what have been described as Scottsbluff and Eden types. These may not be separate types at all but could represent a continuum of variation with intermediate forms that are difficult to classify either way (see Wormington 1957:136).

Artifacts of the Cody Complex are widespread and are found from the lower elevations in intermontane basins to the timberline. An extensive Cody level appeared at the Medicine Lodge Creek site (Frison 1976a; Frison and Wilson 1975) but insufficient charcoal was available for dating in that part of the site where projectile points (for example Figure 2.2g) were recovered. However, in another part of the site that produced several tools (Figure 2.2f) that seem unmistakably of the Cody Complex, the date (RL–446) obtained compares favorably with other known dates of the complex.

Parallel–Oblique Flaked Projectile Points

Fredrick Complex. At the Hell Gap site, the investigators detected a significant morphological change in projectile point types after the Cody Complex. Most noticeable is a technique of parallel–oblique pressure flaking and a loss of the shoulder and stem on the base. The investigators suggest a time period of 8400 to 8000 years ago for the Frederick Complex at the Hell Gap site (Irwin-Williams *et al.* 1973).

Lusk Complex. What may be the terminal Paleo-Indian manifestation (at least in southern Wyoming) is represented by a kind of degenerate Fredrick projectile point called Lusk as represented by materials from the Betty Greene site (Greene 1967) near the town of Lusk in Wyoming. A radiocarbon date of about 7900 years ago (Irwin-Williams *et al.* 1973:51) is believed to date the site. Greene (1968:15) quotes a radiocarbon date (WSU–670) and describes Lusk projectile points as less well made than those of the Fredrick Complex but still somewhat similar.

Pryor Stemmed Complex. The Bighorn Mountains are characterized by a distinctive horizon marker in the form of a projectile point that was given the name of Pryor Stemmed (Husted 1969) because of finding points of this type in radiocarbon-dated deposits near Pryor Mountain in southern Montana. There are a number of radiocarbon dates for sites that have produced this type of projectile point. Among them are Schiffer Cave (RL–99; RL–100) in the southern Bighorn Mountains (Frison 1973a); Occupation III of Bottleneck Cave (SI–240) in Bighorn Canyon in northern Wyoming (Husted 1969); Occupation III of the Sorenson site (I–689) in southern Montana (Husted 1969); the Medicine Lodge Creek site (RL–151; RL–380; see Frison 1976a); the bottom levels of

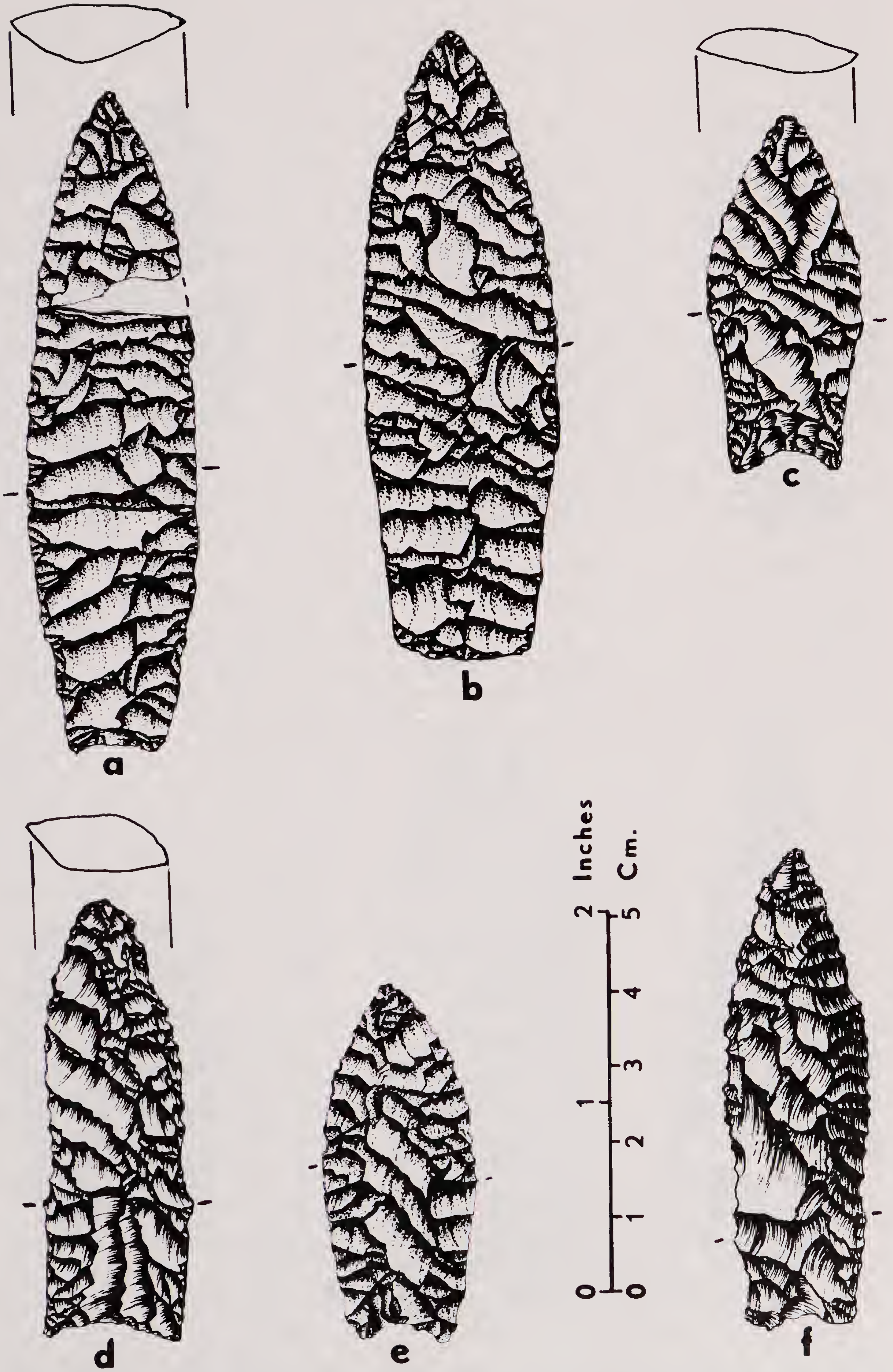


FIGURE 2.3. Projectile points from the Medicine Lodge Creek site (a–d) and Schiffer Cave (e, f).

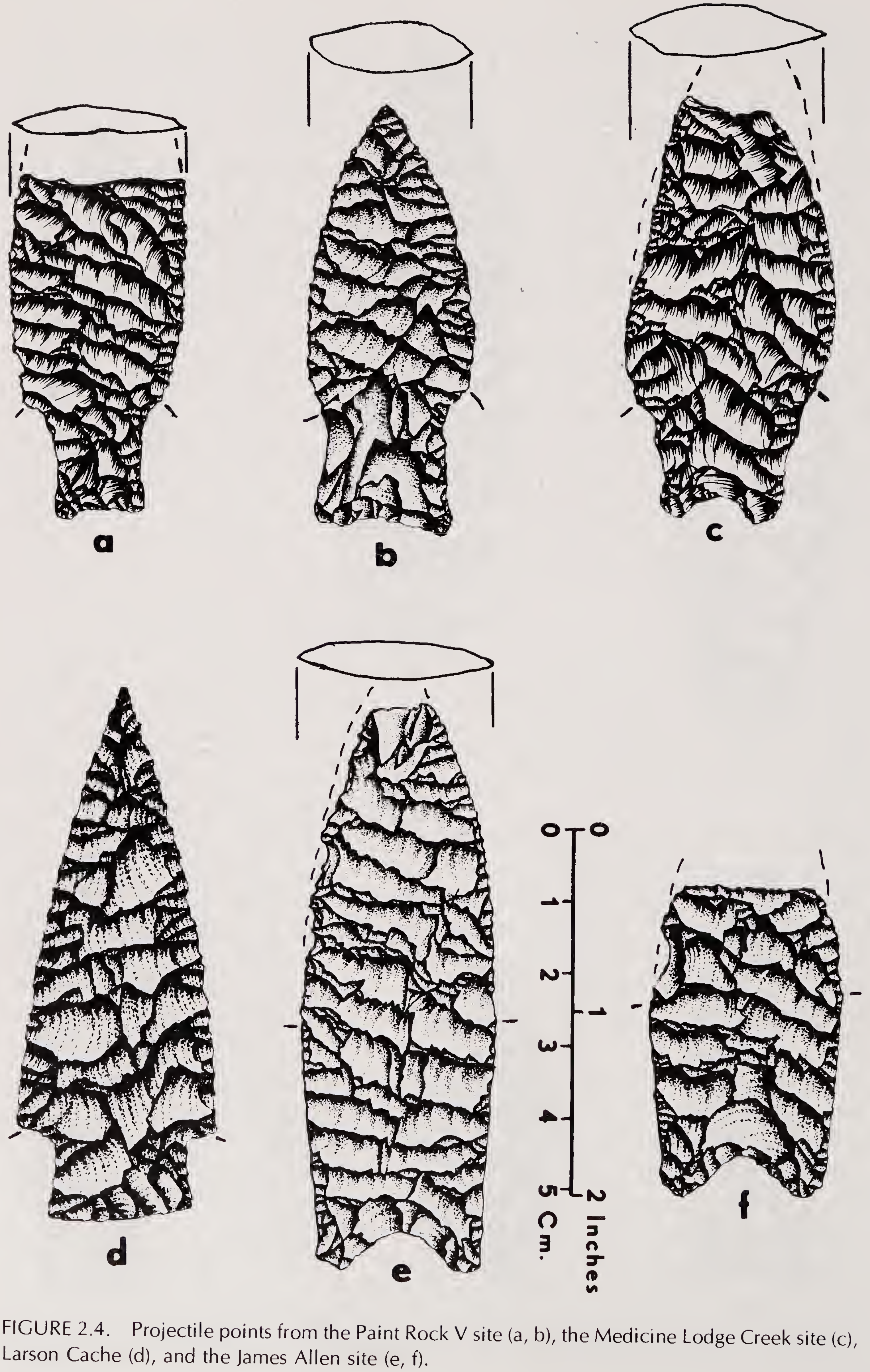


FIGURE 2.4. Projectile points from the Paint Rock V site (a, b), the Medicine Lodge Creek site (c), Larson Cache (d), and the James Allen site (e, f).

Paint Rock V (RL–381; RL–391; see Frison 1976a); a site located close to the Medicine Lodge Creek site; and Site 48JO303, a stratified rockshelter in the south Bighorn Mountain area that has produced several Pryor Stemmed projectile points (A–484); Haynes *et al.* 1966).

Pryor Stemmed points are unique for this part of the Plains in that they were continually reworked on alternate blade edges (Figure 2.3d, f; Figure 2.4a, b) to produce a steep beveling. The archetype was apparently lenticular in transverse cross-section and usually but not always characterized by parallel–oblique pressure flaking. They may have an expanding, parallel-sided, or slightly contracting stem, usually with a basal concavity. Blade edges demonstrate all degrees of beveling, even to the extent that they are narrower than the stem. When this occurred, however, sharp projections were left at the shoulder, suggesting the point was still on a haft. Found also with these distinctive alternate beveled points are lanceolate points with convex blade edges, parallel–oblique flaking, and concave bases (Figure 2.3e). Reworking is common also on broken specimens in the form of crude but deliberate burination on both blade edges and faces using transverse breaks as striking platforms. The latter specimens were apparently reused as tools.

Lovell Constricted. One of the Bighorn Canyon cave sites, Bottleneck Cave in Wyoming, contained what was apparently three well-defined lower levels. A radiocarbon date (SI–237) on the lowest level (Occupation I) dated a cultural level that produced several lanceolate points with crude parallel–oblique flaking, slightly restricted blade edges giving a vaguely stemmed appearance, and concave bases. Husted (1969) gave these the type name of Lovell Constricted after the nearby town of Lovell, Wyoming. At still another stratified cave site in Bighorn Canyon on the Montana site (the Sorenson site), Lovell Constricted points occurred at the second level (Occupation II) and this level was radiocarbon dated (I–612). Similar-appearing specimens (Figure 2.3c) from Medicine Lodge Creek yielded a radiocarbon date of about 8300 B.P. (RL–152). A Lovell Constricted projectile point appeared at Mummy Cave in culture layer 14 (Husted and Edgar n.d.), dated at about 8000 years ago (I–1589).

James Allen. Another assemblage of parallel–oblique flaked projectile points was recovered in a bison kill in the Laramie Basin in southern Wyoming. Known as the James Allen site (Mulloy 1959), it was radiocarbon dated (M–304) and the projectile points are characterized by either slight lateral restrictions or parallel sides (Figure 2.4e, f) and deeply concave bases somewhat reminiscent of the points of the Fredrick Complex.

Angostura. Still another occurrence of parallel–oblique flaked projectile points was at the Ray Long site (Hughes 1949) in western South Dakota, where two dates (C–454 and M–370) were obtained (see Wormington 1957:138–141). The former is regarded as a doubtful association, and the latter is associated with what were named Angostura projectile points (Wheeler 1954a). Angostura, Fredrick, James Allen, Lusk, and others may be local or regional variants of the terminal Paleo-Indian manifestation for the Northwestern Plains.

Other Parallel-Oblique Flaked Projectile Points. Parallel–oblique pressure flaking appeared in other areas before it appeared at the Hell Gap site. At Mummy Cave (Wedel *et al.* 1968) a projectile point sequence with this distinctive pressure flaking began in a cultural level with a radiocarbon date of over 9000 B.P. (I–2356). Other dates extending to about 8100 B.P. (I–2355; I–2353; I–2354; I–1589) were recovered from Mummy Cave on a number of parallel–oblique flaked projectile points, all lanceolate and varying in outline form between those having slight lateral restrictions toward the base and concave bases and those having convex blade edges and straight bases.

The Medicine Lodge Creek site contained several feet of deposits that yielded radiocarbon dates on parallel–oblique, parallel–transverse, or combinations of the two flaked projectile points. Included are dates from about 8500 B.P. (RL–388); a divided sample yielded dates of about 8000 and 8600 B.P. (RL–384; RL–384a). Some of the dated projectile points (Figure 2.3a, b) are similar to those at Mummy Cave. The most recent Paleo-Indian level at Medicine Lodge Creek (about 8000 B.P.; RL–395) produced a stemmed, lanceolate point with both parallel–oblique and parallel–transverse flaking. It could be a Pryor Stemmed specimen on which the blade edges were not yet beveled (Figure 2.4c) or something later in time. Stratigraphically it was above the Pryor Stemmed levels.

In what is now Bighorn Lake, straddling the Montana–Wyoming line, were a number of cave sites that were excavated as part of the Smithsonian River Basin salvage program. The lower levels of three caves produced parallel–oblique flaked, lanceolate projectile points (Husted 1969). Occupation I from the Mangus site in Montana produced two radiocarbon dates (SI–98; SI–101) on a lanceolate projectile point type with a straight base, convex blade edges, and some evidence of parallel–oblique flaking; similar point has a convex base with definite evidence of parallel–oblique flaking. Also found at this site were some rather nondescript points with poorly defined stems. A long, narrow projectile point with parallel–oblique flaking and a rounded base (Figure 2.5b) was recovered from Southsider Cave just above a level dated at 8500 B.P. (RL–666).

Another stratified site of importance is the Myers–Hindman site in the Upper Yellowstone River Valley near Livingston, Montana (Lahren 1976). A thick, sterile level separates the two deepest cultural units and the oldest contains several projectile points in style and technology reminiscent of those from Bighorn Canyon and Medicine Lodge Creek sites. Included are rounded base and concave base styles with both parallel–oblique and/or parallel–transverse flaking (Lahren 1976:63). Another style resembles Scottsbluff; there is still another, which Lahren calls Pinto. There are also notched projectile points, which out of context could easily be mistaken for something common to the Late Plains Archaic (Lahren 1976). There are other indications that similar notched projectile points were present in the Bighorn Basin and Upper Yellowstone River valley at a surprisingly early date. However, the points have not yet been recovered in the proper context for an exact stratigraphic position

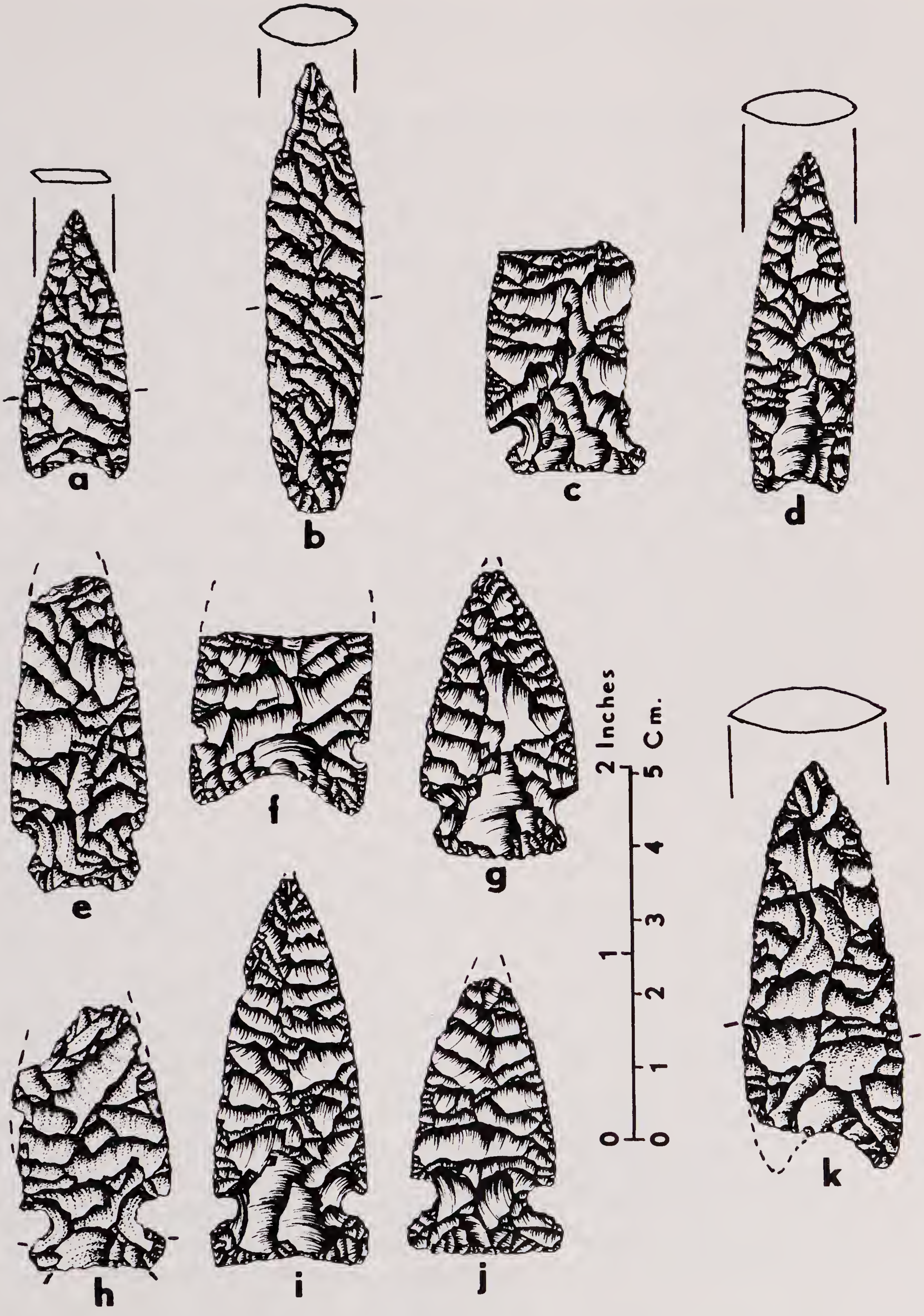


FIGURE 2.5. Projectile points from Southsider Cave (a–d, f, g), Wedding of the Waters Cave (e), the Laddie Creek site (h, j), the Lookingbill site (i), and the Medicine Lodge Creek site (k).

to be assigned to them; neither can the cultural materials associated with them be defined. A good series of dates was recovered for the Myers–Hindman site (Table 2.8).

Other Poorly Known Paleo-Indian Projectile Point Types

The deepest cultural level at the Medicine Lodge Creek site produced a projectile point with a convex base, parallel–transverse flaking, and blade edges parallel for a distance from the base before they begin to converge toward the point (Figure 2.2a). It is reminiscent of the Plainview type best known from the Southern Plains (Sellards *et al.* 1947) and the radiocarbon date on the level is about 9700 B.P. (RL–154). A radiocarbon date of about 9600 B.P. (RL–153) apparently dates a level containing a projectile point with a parallel stem and rounded base (Figure 2.2c). These points are rather common surface finds (see, for example, Figure 2.2d) in the area but this is the first known occurrence in a datable context. They resemble projectile points recovered at the Lind Coulee site (see Wormington 1957:187–190), but no cultural connection is suggested here by the similarity.

Another level at Medicine Lodge Creek is just above a bison tibia from which a date of 9510 B.P. ± 260 (RL–450) was obtained. This cultural level produced one projectile point and part of another characterized by nearly straight blade edges; wide, shallow lateral restrictions; and a distinctive split base. The lateral restrictions and base are heavily ground. These are also regular surface finds in the area (Figure 2.2b). a number of variations of this projectile point style also appear, and one (Figure 2.2e) from Medicine Lodge Creek is dated at about 9300 B.P. (RL–150). An almost identical date is from Southsider Cave (RL–665) and may date a concave or split-based projectile point reminiscent of those from Medicine Lodge Creek but one which unfortunately was not found in an unquestionable stratigraphic position.

Southsider Cave also produced a level that contained a projectile point (Figure 2.5a) that in outline form resembles a later type known as McKean lanceolate. Blade edges, however, were ground in the Paleo-Indian style. The level was dated at 8500 B.P. (RL–666). A similar projectile point from Medicine Lodge Creek (Figure 2.5k) was obtained a short distance stratigraphically below a radiocarbon-dated level of about 8500 B.P. (RL–388), and the same date is from a level that produced lanceolate projectile points with both parallel–oblique and parallel–transverse flaking and concave bases (Figure 2.3a). All these poorly known parallel–oblique and other types need to be defined better.

Another site, Little Canyon Creek Cave 48WA323, in the southern Bighorn Basin has produced two early radiocarbon dates of about 10,200 B.P. (RL–641) and 8800 B.P. (RL–640) on the two bottom levels but diagnostic cultural materials were found only in the youngest. There seems no reason to doubt that more dates and projectile point associations may appear in future work at the site.

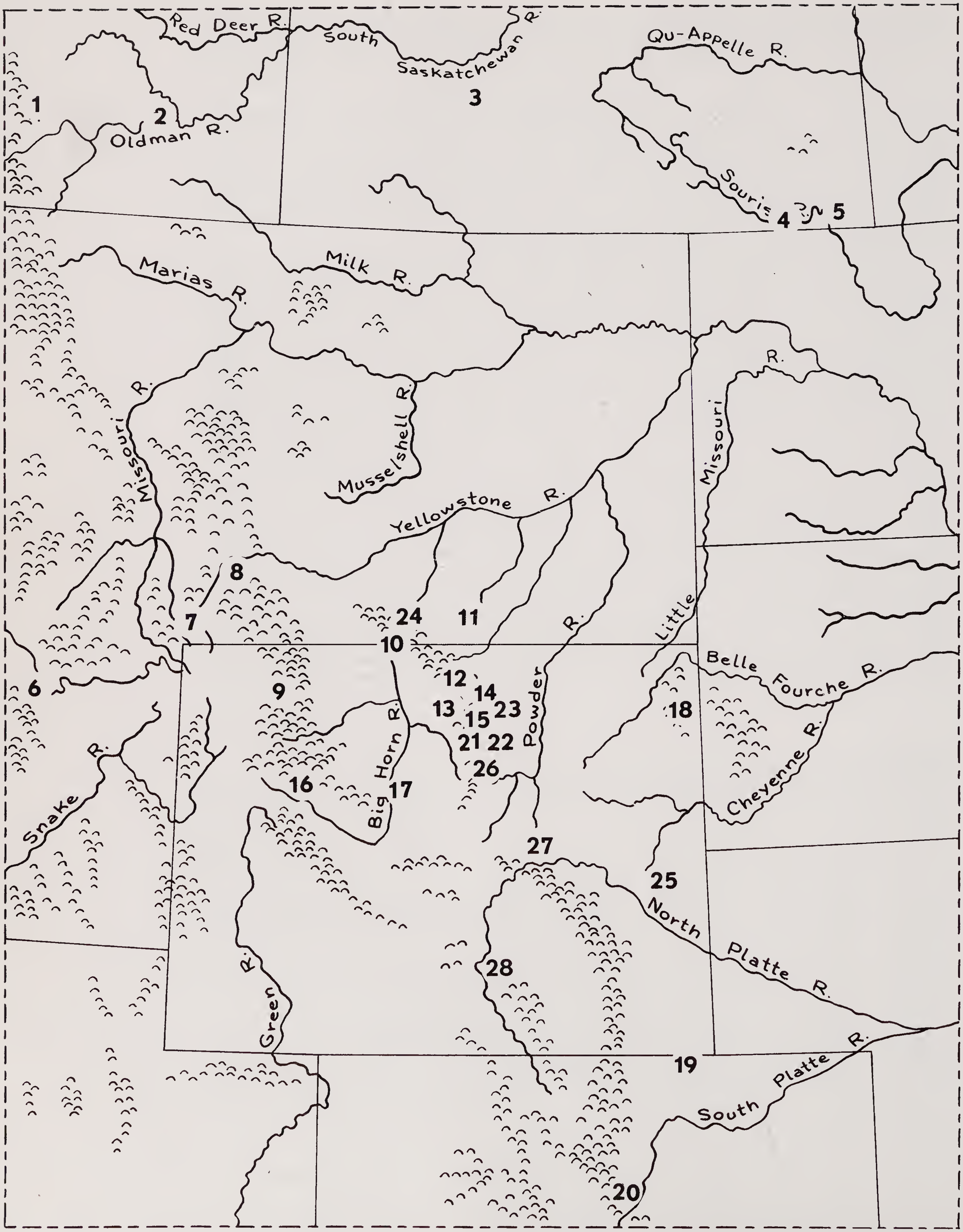
The Altithermal or Early Plains Archaic Period

Radiocarbon dates for the Early Plains Archaic period are presented in Tables 2.4 through 2.9. Site locations are given in Figure 2.6. At one time it was thought that the Altithermal period might have coincided with a cultural hiatus on the Plains. This hypothesis may be partially correct, as cultural evidence to date during the period is lacking from the open Plains. This lack could be interpreted as a sign that the climatic conditions of the period did result in the exclusion of human habitation to a large extent. Another possibility is that the evidence has simply not been found because of erosion and deposition. Whatever the truth is, there is ample evidence of the Early Plains Archaic cultural groups in the foothill–mountain areas and in most areas of greater topographic relief along mountain slopes and isolated uplifts.

The best radiocarbon-dated chronological record of Early Plains Archaic occupations for this area is found in Mummy Cave, which is located along the Shoshone River a few miles east of Yellowstone National Park in Park County, Wyoming. Only a very brief summary has been published (Wedel *et al.* 1968). The beginning of the period is marked by an abrupt change in projectile point styles from the lanceolate Paleo-Indian types to the side-notched Early Plains Archaic types. The earliest dates known for these side-notched projectile points is one from Mummy Cave at about 7600 B.P. (I–1588) and another of nearly 7700 B.P. (UGa–957) from the Pretty Creek site (unpublished) located at Pryor Gap in south central Montana. The former is from cultural layer 16 in the cave from which a number of projectile points were obtained that Husted (Husted and Edgar n.d.:101) called five Blackwater Side-Notched and a sixth specimen Pahaska Side-Notched (Husted and Edgar n.d.:102). Several others found at this level are reminiscent of those of a much later date. Both type names are from local place names. The Pretty Creek projectile points are similar to some of those from level 16 at Mummy Cave. Another radiocarbon date of about

TABLE 2.9
Radiocarbon Dates of the Early Plains Archaic Period

Lab. No.	Date		Site
RL–676	4430 ± 140	(2480 B.C.)	Carter Cave, Wyo.
RL–483	4730 ± 140	(2780 B.C.)	Paint Rock V, Wyo.
C–451	5020 ± 300	(3070 B.C.)	Near bottom of Altithermal channel, Lindenmeier, Colo.
RL–675	5100 ± 330	(3150 B.C.)	Rice Cave, Wyo.
RL–689	5220 ± 150	(3270 B.C.)	Shoreline Site, Wyo.
RL–543	5250 ± 150	(3300 B.C.)	Dunlap-McMurry Burial, Wyo.
RL–651	5350 ± 160	(3400 B.C.)	Dunlap-McMurry Burial, Wyo.
RL–390	5390 ± 120	(3440 B.C.)	Granite Creek Rockshelter, Wyo.
RL–490	5500 ± 140	(3550 B.C.)	Wedding of the Waters Cave, Wyo.
RL–484	6010 ± 170	(4060 B.C.)	Hawken III, Wyo.
RL–677	6200 ± 170	(4250 B.C.)	Spanish Point, Wyo.
RL–437	6270 ± 170	(4320 B.C.)	Hawken, Wyo.
RL–185	6470 ± 140	(4520 B.C.)	Hawken, Wyo.
RL–691	5700 ± 160	(3750 B.C.)	Laddie Creek, Wyo.
RL–692	6650 ± 480	(4700 B.C.)	Laddie Creek, Wyo.
RL–445	6830 ± 260	(4880 B.C.)	Laddie Creek, Wyo.
RL–554	7140 ± 160	(5190 B.C.)	Lookingbill, Wyo.
UGa–957	7685 ± 580	(5735 B.C.)	Pretty Creek, Mont.


Red Deer R.
South Saskatchewan R.
Qu-Appelle R.
Oldman R.
Souris
Milk R.
Marias R.
Missouri R.
Musselshell R.
Yellowstone R.
Missouri R.
Little
Belle Fourche R.
Cheyenne R.
Powder R.
Big Horn R.
Snake R.
Green R.
North Platte R.
South Platte R.
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7100 B.P. (I–1587) is from cultural level 18, which produced 17 Pahaska Side-Notched specimens. The same type appeared also in culture layers 17 and 19. From culture layer 20, a radiocarbon date of 5800 B.P. (I–2350) was derived from a level containing a single slightly different early side-notched projectile point. Layer 21 yielded a date of about 5600 B.P. (I–1585) but no diagnostic markers; culture layer 24 produced a date of about 5400 B.P. (I–1466) on both side-notched and a rather distinctive expanding-stem projectile point style with either a straight or a concave base.

The last radiocarbon date at Mummy Cave that is from the Early Plains Archaic period is one of about 5250 B.P. (I–1429) from charcoal in cultural layer 38. A side-notched projectile point with a deeply indented base occurred in this level along with several slight variants. The next date from the site is of the Middle Plains Archaic period McKean Complex, which will be considered later in this chapter.

At the Medicine Lodge Creek site, the Early Plains Archaic period was marked by a hiatus in the depositional record. Occasionally a discontinuous level appeared that produced the diagnostic early side-notched projectile point but none has yielded enough charcoal for a radiocarbon date. However, all the Early Plains Archaic projectile point types that appeared at Mummy Cave were also found at Medicine Lodge Creek; unfortunately, except for those in undated discontinuous levels, all were in degraded deposits. However, a number of other radiocarbon-dated sites of the Early Plains Archaic have been found in the area. A small site, Granite Creek Rockshelter, was salvaged ahead of highway construction in Shell Canyon about 15 miles east of Shell, Wyoming; early side-notched projectile points were dated there at about 5400 B.P. (RL–390). As at Mummy Cave, the next cultural level above this was of the McKean Complex.

A date of about 5500 B.P. ago (I–692) was placed on early side-notched projectile points recovered at the stratified Sorenson site in Bighorn Canyon (Husted 1969). As at Mummy Cave and Granite Creek Rockshelter, the next youngest cultural level produced McKean Complex materials. The same condition appeared at Wedding of the Waters Cave (Frison 1962) at the opposite end

FIGURE 2.6. Archeological sites of the Early Plains Archaic period. 1: Gap (Reeves and Dormaar 1972); 2: Head-Smashed-In Buffalo Jump (Reeves 1974); 3: Gray Burial (Millar *et al.* 1972); 4: Long Creek (Wettlaufer and Mayer-Oakes 1960); 5: Oxbow Dam (Nero and McCorquodale 1958); 6: Birch Creek (Swanson *et al.* 1964); 7: Carbella 24PA302 (Arthur 1966); 8: Myers–Hindman 24PA504 (Lahren 1976); 9: Mummy Cave 48PA201 (Husted and Edgar n.d.; Wedel *et al.* 1968); 10: Bighorn Canyon Caves 24CB202, 24CB221, 48BH206 (Husted 1969); 11: Kobold 24BH406 (Frison 1970b); 12: Granite Creek Rockshelter 48BH330 (Frison and Wilson 1975); 13: Medicine Lodge Creek 48BH499 (Frison 1976a); 14: Paint Rock V 48BH349 (Frison 1976a); 15: Laddie Creek 48BH345 (this volume); 16: Lookingbill 48FR308 (Frison 1976a); 17: Wedding of the Waters Cave 48HO301 (Frison 1962); 18: Hawken 48CK303 (Frison *et al.* 1976); 19: Wilbur Thomas 5WL45 (Breternitz 1971); 20: Magic Mountain (Irwin-Williams and Irwin 1966); 21: Southsider Cave 48BH364 (this volume); 22: Rice Cave 48WA363 (this volume); 23: Carter Cave 48WA365 (this volume); 24: Pretty Creek 24CB4 (unpublished); 25: Hell Gap 48GO305 (Irwin-Williams *et al.* 1973); 26: Leigh Cave 48WA304 (Frison and Huseas 1968); 27: Dunlap-McMurry Burial 48NA67 (Zeimens *et al.* 1976); 28: Shoreline Site 48CR122 (Walker and Zeimens 1976).

of the Bighorn Basin. The site produced a sequence of Middle and Late Plains Archaic cultural levels and in 1975 a rockfall was removed to test for older cultural levels. Results produced a level with Early Plains Archaic projectile points (Figure 2.5e) radiocarbon dated at 5500 B.P. (RL–490). A deeply stratified open site (Laddie Creek site) is in the rough, mountainous country higher up on the western slopes of the Bighorn Mountains, at an elevation of about 7000 feet. At least six levels of Early Plains Archaic are present and three have been radiocarbon dated (RL–445; RL–691; RL–692). Side-notched projectile points (Figure 2.5h, j) were also recovered. Southsider Cave produced a number of radiocarbon-dated Early Plains Archaic levels from about 5400 to about 7600 B.P. (RL–670; RL–671; RL–667; RL–669). A large sample of projectile points was recovered here that demonstrate variations of the time period (Figure 2.5c, f, g). What would appear to be a rather late date for the Early Plains Archaic, about 4700 B.P. (RL–483), was derived from a fire pit in another cave site (Paint Rock V) in the mountains east of the Medicine Lodge Creek site. This also is from directly underneath a McKean cultural level. Leigh Cave (Frison and Huseas 1968) recently was proved to have an Early Plains Archaic level underlying McKean. Rice Cave produced several levels and large numbers of Early Plains Archaic cultural material, but only one radiocarbon date, 5100 B.P. (RL–675), was obtained because of a paucity of charcoal. A radiocarbon date of about 4430 B.P. (RL–676) from Carter Cave is in direct association with Early Plains Archaic type projectile points, but the date seems too recent. At the Lookingbill site, a high-altitude site in the southern Absaroka Mountains, a radiocarbon date of about 7100 B.P. (RL–554) was derived from a cultural level that produced one of our best samples of cultural material including projectile points (Figure 2.5i) along with the complete production sequence.

A date of about 6200 B.P. (RL–677)came from charcoal recovered in a pit at the Spanish Point quarry in the northern Bighorn Mountains. Two dates of about 5300 B.P. (RL–543 and RL–651) are from a burial recovered in road building operations north of Casper, Wyoming (Zeimens *et al.* 1976). Initial investigations in a site (the Shoreline site 48CR122) along the Seminoe Reservoir in Carbon County, Wyoming have producedwhat appear to be pit house features with fire hearths. One structure has been excavated and a single large side-notched projectile point was recovered. The fire hearth produced a date of about 5200 B.P. (RL–689). This site will undoubtedly be important to studies of the Early Plains Archaic.

A bison kill containing an extinct variant of bison (*B. bison occidentalis*) in the Wyoming part of the Black Hills produced the largest known sample of Early Plains Archaic projectile points from a single site component. This site, the Hawken site, has two radiocarbon dates, of about 6500 and 6300 B.P. (RL–185; RL–437). The site was an arroyo trap, but no camp, butchering, or meat processing areas were found (Frison *et al.* 1976). Another site (Hawken III) was discovered in the same general area. It contained a large sample of butchered bison and had the same general characteristics found at Hawken. The Hawken III site yielded a radiocarbon date of about 6000 B.P. (RL–484).

The Myers–Hindman site near Livingston, Montana (Lahren 1976), also produced radiocarbon-dated early side-notched (or Bitterroot) cultural material (GX–1490, GaK 2632). A fire pit interpreted as being in a late Altithermal soil at the Hell Gap site yielded a radiocarbon date of about 5700 B.P. (A–498), but no cultural material is described (Haynes *et al.* 1966).

Bitterroot side-notched projectile points have been known and described from further west in Idaho for some time and do apparently represent a late Altithermal or early post-Altithermal occurrence there (see Swanson *et al.* 1964). Relationships further to the east are not yet resolved but Logan Creek (Kivett 1962) materials seem to have close relationships both temporally and typologically. With more intensive archeological work now going on, it seems inevitable that we will see many more Early Plains Archaic sites in the near future.

I should add here that a cultural complex with side-notched projectile points is present on the Northern Plains and appears at about the same time as the terminal Early Plains Archaic and early Middle Plains Archaic periods further south. This has been named the Oxbow Culture from sites in southern Saskatchewan with radiocarbon dates of 5193 B.P. ± 130 (S–44) at the Oxbow Dam site (Nero and McCorquodale 1958), and 4643 B.P. ± 150 (S–53) and 4613 B.P. ± 150 (S–50) at the Long Creek site (Wettlaufer and Mayer-Oakes 1960). Two sites at least with Oxbow components are known from Alberta. The first is the Castor site (Wormington and Forbis 1965), with an estimated date of 5000 to 4000 B.P. A date of 4050 B.P. ± 100 (GaK–1416) is given for a late Oxbow component at the second site, Head-Smashed-In Buffalo Jump in Alberta (Reeves 1973:1241).

Some sites suggest Oxbow and McKean mixing (see Reeves 1973) and this is a distinct possibility. Some cultural materials that occur toward the end of the Early Plains Archaic period are reminiscent of Oxbow. This is certainly true from the Mummy Cave, Southsider Cave, and Rice Cave assemblages. The Mummy Cave, Dead Indian Creek site, and Southsider Cave materials suggest a continuity in projectile point styles at least from the Early Plains Archaic into McKean or Middle Plains Archaic.

Reeves (1974) has adopted the concept of a Mummy Cave phase to accommodate the earliest known components at Head-Smashed-In Buffalo Jump in Alberta, apparently using these kinds of observed similarities. Head-Smashed-In Buffalo Jump is an especially important site for the Northern Plains. On the basis of present evidence, a rather close prehistoric cultural relationship is suggested between the Northern Plains and the Northwestern Plains. The sequence of radiocarbon dates for the site is especially significant (Table 2.10).

Not all the projectile point styles of the Early Plains Archaic period are well enough known for us to postulate whether they form separate types or are merely variations of existing types. For example, large corner-notched points, some with and some without base notches, were found in culture layer 16 of Mummy Cave (Husted and Edgar n.d.) and in the Early Plains Archaic levels at Laddie Creek (see Chapter 5, Figure 5.30c) with dates of around 7000 to 7600

TABLE 2.10
Radiocarbon Dates from Head-Smashed-In Buffalo Jump[a]

Lab. No.	Date	Site
GSC-992	700 ± 170 (A.D. 1250)	Old Women's
RL-257	1190 ± 90 (A.D. 760)	Initial Old Women's
RL-256	1000 ± 110 (A.D. 950)	Terminal Avonlea
GSC-983	1040 ± 140 (A.D. 910)	Terminal Avonlea
GaK-1475	1860 ± 120 (A.D. 90)	Initial Avonlea
GX-1252	1645 ± 130 (A.D. 305)	Initial Avonlea
RL-330	1840 ± 90 (A.D. 110)	Initial Avonlea
GX-1253	1925 ± 80 (A.D. 25)	Pelican Lake
RL-332	2690 ± 90 (740 B.C.)	Initial Pelican Lake
Gak-1475	3040 ± 120 (1090 B.C.)	Initial Pelican Lake
GaK-1416	4050 ± 100 (2100 B.C.)	Terminal Mummy Cave
RL-333	5080 ± 120 (3130 B.C.)	Terminal Mummy Cave
GSC-803	5410 ± 300 (3460 B.C.)	Initial Mummy Cave
RL-334	5660 ± 100 (3710 B.C.)	Initial Mummy Cave

[a] Data from Reeves 1974.

B.P. The same style of point appeared also in stream gravels lying between the terminal Paleo-Indian and Middle Plains Archaic levels at the Medicine Lodge Creek site.

Toward the end of the Early Plains Archaic a wide range of projectile point styles appear. For example, at culture layer 24 of Mummy Cave (Husted and Edgar n.d.), which was dated at about 5400 years ago, were a number of projectile points that out of context could easily fit into the Late Plains Archaic. The same holds true for the Laddie Creek site, Southsider Cave, and the Sorenson site in Bighorn Canyon (Husted 1969). Similar undated materials were present at the lowest level of the Kobold site (Frison 1970b) but these were below the bison-jumping levels and apparently represent a small campsite.

The inability to place this type of material within a proper time frame has affected archeological interpretations in the past. Much of the supposed lack of human occupation on the Northwestern Plains during the Early Plains Archaic is due to archeologists' inability to interpret the evidence. The evidence was there but it was regarded as a manifestation of a later time period.

The Middle Plains Archaic Period

Middle Plains Archaic period radiocarbon dates are given in Tables 2.3–2.8 and 2.11. Site locations are given in Figure 2.7.

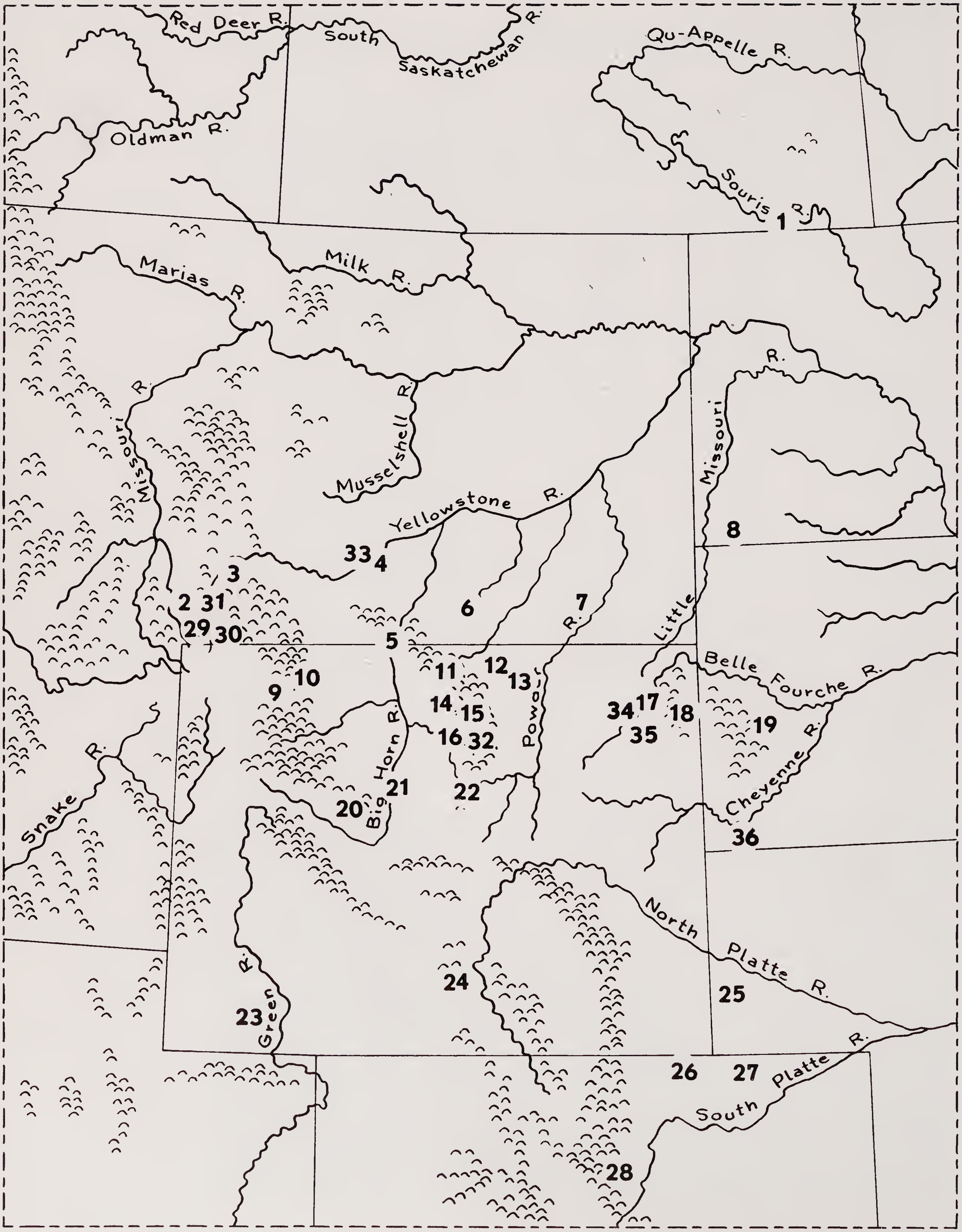
The appearance of the McKean Complex is almost dramatic; suddenly there is cultural evidence in an area that was hitherto relatively devoid of such evidence. During the Middle Plains Archaic period human groups moved into the open Plains and the interiors of intermontane basins, and they seem to have

TABLE 2.11
Radiocarbon Dates of the Middle Plains Archaic Period

Lab. No.	Date		Site
C 667	1646 ± 200	(A.D. 304)[a]	Belle Rockshelter, Wyo.
RL–160	2460 ± 140	(510 B.C.)	Mavrakis–Bentzen–Roberts, Wyo.
I–644	2600 ± 200	(650 B.C.)	Mavrakis–Bentzen–Roberts, Wyo.
C 668	2790 ± 350	(840 B.C.)[b]	Mule Creek Rockshelter, Wyo.
RL–162	2910 ± 140	(960 B.C.)	48SH312, Wyo.
I–410	4450 ± 125	(2500 B.C.)	Powers–Yonkee, Mont.
UGa–456	3180 ± 80	(1230 B.C.)	Dipper Gap, Colo.
UGa–453	3410 ± 90	(1460 B.C.)	Dipper Gap, Colo.
UGa–455	3520 ± 85	(1570 B.C.)	Dipper Gap, Colo.
I (?)	4130 ± 130	(2180 B.C.)	Gant, S. Dak.
A–483	3450 ± 40	(1500 B.C.)	48JO303, Wyo.
A–485	3980 ± 70	(2030 B.C.)	48JO303, Wyo.
Grey No. 25	4170 ± 150	(2220 B.C.)	Leigh Cave, Wyo.
M–368	3630 ± 350	(1700 B.C.)	Kolterman, S. Dak.
M–369	4230 ± 350	(2280 B.C.)	Kolterman, S. Dak.
RL–482	4310 ± 140	(2360 B.C.)	Paint Rock V, Wyo.
RL–321	3800 ± 110	(1850 B.C.)	Dead Indian Creek, Wyo.
W–2597	4180 ± 250	(2230 B.C.)	Dead Indian Creek, Wyo.
W–2599	4430 ± 250	(2480 B.C.)	Dead Indian Creek, Wyo.
L–385D	4170 ± 250	(2220 B.C.)	Signal Butte, Nebr.
L–385B	4550 ± 22	(2600 B.C.)	Signal Butte, Nebr.
RL–174	4540 ± 110	(2590 B.C.)	Scoggin, Wyo.
RL–389	4700 ± 130	(2750 B.C.)	Granite Creek Rockshelter, Wyo.
W-1135	4900 ± 300	(2950 B.C.)	Rigler Bluffs, Mont.
Grey No. 29	5040 ± 150	(3090 B.C.)	Rigler Bluffs, Mont.
RL-470	4250 ± 140	(2300 B.C.)	Hawken II, Wyo.

[a] Date rejected.
[b] Date considered too recent.

increased their emphasis on plant foods. In the dry interior of the Bighorn Basin, for example, the diagnostic artifacts (besides projectile points) are the flat sandstone grinding slab and sandstone mano (see Chapter 10, Figures 10.2 and 10.3). Along with these are found large numbers of roasting pits (see, for example, Mulloy 1954a; 1965a; see also this volume, Chapter 10, Figure 10.4). These pits are usually found in sandy or clay areas, which were easier to dig into with simple tools. They vary considerably; some are quite large and hold 100 lb or more of fire-fractured stones, but others are relatively small; some are quite deep, but others are shallow; bottoms are usually flattened with rounded edges, but some have more globular shapes. These types of pits continued for several thousand years with little or no functional changes, although they were sometimes lined with slabs of sandstone or, in rare cases, flattened river cobbles. Some were used only once, whereas others were cleaned out and reused. The deep pits often had a succession of fires from top to bottom and presumably when filled completely were then cleaned out to the bottom and the


Red Deer R.
South Saskatchewan R.
Qu-Appelle R.
Oldman R.
Souris R.
1
Milk R.
Marias R.
Missouri R.
Musselshell R.
Yellowstone R.
Missouri
R.
8
33
4
3
2
31
29
30
6
7
R.
5
Little Missouri
Belle Fourche R.
10
9
11
12
13
14
15
16
32
Powder
34
17
18
35
19
Cheyenne R.
Snake R.
Big Horn R.
21
20
22
36
North Platte R.
Green R.
23
24
25
26
27
South Platte R.
28

sequence repeated. The principle of operation was that of a simple oven. A fire is built and at the proper stage stones were placed in the fire and heated. The hot stones serve as a heat source for roasting both plant and animal foods. There is evidence that grinding slabs were used much earlier in time but the beginning Middle Plains Archaic is when the true mano and grinding slab made their debut in the area. These items, however, are not as reliable as projectile points for chronological markers because they span several thousand years of time with no discernible changes in style.

I do not believe that this cultural and economic change represents human groups of vegetarians who excluded the larger game animals from their diet. The evidence is very much to the contrary and suggests instead a carefully calculated scheduling of economic activities to coincide with food sources in a wide range of ecological areas from season to season. Many aspects of seasonality of economic activities have not been satisfactorily resolved although animal population studies on faunal remains have proven the most reliable determiner to date.

The term *McKean* has been the subject of much controversy, largely because of the apparent wide variance in projectile point types found in the various site assemblages regarded as part of the McKean Complex. The McKean site (Mulloy 1954b) produced cultural materials of the McKean Complex as well as later materials at a higher level. The investigator regarded the projectile point assemblage as a range of variation of a single point type. Another investigator who worked in the same area (Wheeler n.d.) and excavated in a number of sites of the McKean Complex named separate projectile point types rather than regarding the points as variations of a single type. The problem is still with us; no model yet proposed to accommodate these disparate styles has offered any real solutions. In some cases—for example, single-event bison kills—a single variant of the McKean range of projectile points may appear (see, for example, Bentzen 1961; Frison 1968c). In some campsites the same is

FIGURE 2.7. Archeological sites of the Middle Plains Archaic period. 1: Long Creek (Wettlaufer and Mayer-Oakes 1960); 2: Carbella 24PA302 (Arthur 1966); 3: Myers–Hindman 24PA504 (Lahren 1976); 4: Pictograph Cave 24YL1 (Mulloy 1958); 5: Big Horn Canyon Cave 24CB202 (Husted 1969); 6: Kobold 24BH406 (Frison 1970b); 7: Powers–Yonkee 24PR5 (Bentzen 1961); 8: Fisher and Red Fox 32BO207, 32BO213 (Syms 1969); 9: Mummy Cave 48PA201 (Wedel *et al.* 1968); 10: Dead Indian Creek 48PA551 (Smith 1970); 11: Granite Creek Rockshelter 48BH330 (Frison and Wilson 1975); 12: Mavrakis–Benson–Roberts 48SH311 (Bentzen 1962); 13: Powder River 48SH312 (Frison 1968c); 14: Medicine Lodge Creek 48BH499 (Frison and Wilson 1975); 15: Paint Rock V 48BH349 (Frison and Wilson 1975); 16: Leigh Cave 48WA304 (Frison and Huseas 1968); 17: McKean 48CK7 (Mulloy 1954b); 18: Hawken II 48CK303 (this volume); 19: Gant 39ME9 (Gant and Hurt 1965); 20: Birdshead Cave 48FR54 (Bliss 1950); 21: Wedding of the Waters Cave 48HO301 (Frison 1962); 22: 48JO303 (Haynes *et al.* 1966); 23: Pine Spring 48SW101 (Sharrock 1966); 24: Scoggin 48CR304 (Lobdell 1973); 25: Signal Butte (Strong 1935); 26: Wilbur Thomas 5WL45 (Breternitz 1971); 27: Dipper Gap 5LG101 (Metcalf 1973); 28: LoDaisKa (H. Irwin and C. Irwin 1959); 29: Rigler Bluffs 24PA401 (Arthur 1966); 30: Eagle Creek 24PA301 (Arthur 1966); 31: Sphinx 24PA508 (Lahren 1971); 32: Southsider Cave 48BH364 (this volume); 33: Billings Bison Trap (Mulloy 1958); 34: Belle Rockshelter 48CK4 (Wheeler n.d.); 35: Mule Creek Rockshelter 48CK204 (Wheeler n.d.); 36: Kolterman 39FA68 (Crane 1956; Wheeler n.d.).

also true, but in other campsites, including the McKean site itself, nearly the full range appears. Some investigators have suggested that the different variants in a single site might represent different bands coming together for special occasions. Both functional differences and differences in raw materials have also been suggested as causes for the variants but neither has been proven true. Also suggested are different occupations in the same site that represent slight temporal differences, which we are as yet unable to detect in the stratigraphic record. This seems extremely unlikely considering that the situation has occurred in so many different contexts. We seem at this time to be forced to accept the conclusion that Middle Plains Archaic cultural groups on the Northwestern Plains and especially in the Plains–foothills areas were manifest by a large number of projectile point types and styles with no satisfactory explanation of their presence.

The projectile points in question include the true McKean lanceolate type with indented base and convex blade edges that are slightly narrower at the base than toward the middle. A stemmed form with sloping shoulders has been called *Duncan* and a form with distinct shoulders and a slightly expanding stem has been called *Hanna* (Wheeler 1954b). Other variations include those with long, shallow lateral restrictions and others with true side-notches. Bases may be concave or deeply indented and some may demonstrate a true base-notch. Even the lanceolate form varies considerably. One persistent but minor form (in terms of numbers) is a relatively large heart-shaped variety. Unlike Paleo-Indian projectile points that are similar in outline form, these points rarely evidence grinding of stems or blade edges.

Another variant point found in McKean sites is wide, very thin, with deep side-notches placed well forward, and with either straight, slightly concave, or deeply indented base. Sometimes the addition of a deep, narrow basal notch is seen. These points were found at Signal Butte, where they were given the type name of *Mallory* (Forbis *et al.* n.d.). This type and true McKean lanceolates occurred in a temporally restricted bison trap site situation in central Wyoming, leaving no doubt of the co-occurrence of the two (Lobdell 1973).

Other bison kills restricted to the Middle Plains Archaic in the Powder River Basin of Wyoming and southern Montana produce what may be a McKean projectile point variant. They are usually found in a rather distinctive type of arroyo bison kill (Bentzen 1961, 1962; Frison 1968c). They appear also in a bison jump in the Powder River Basin (Frison 1970b). The projectile points are usually side-notched and occasionally corner-notched and have either deep basal indentations or base notches, although toward the end of the period there is more stylistic variation. Whether or not these represent part of the McKean Complex, they were in the same general area at the right time and were doing some rather sophisticated bison procurement. There has been a tendency to refer to these as *Yonkee* projectile points after the landowner on whose property a large number of these points appeared in contexts with several hundred bison in an arroyo kill situation (Bentzen 1961).

Stone Circles

During the Middle and Late Plains Archaic and the Late Prehistoric periods, large numbers of stone circles appeared in the Northwestern Plains (Figure 2.8). They appear nearly everywhere, singly and in groups that occasionally reaches into the hundreds. Buttes and less-noticeable topographic rises are common locations, and ridge tops may be lined with them. They may line terraces along streams or dry arroyos. They occur in the arid, interior intermontane basins, on the open Plains, in the foothills, and even (with less frequency) in the high mountains. Groups of these may actually be contiguous over large areas.

Sizes vary from about 11 feet to 24 feet in diameter although some are smaller and some are larger. They may be composed of a single course of stones either touching or some distance apart. Or they may be composed of a wide band of stones, suggesting that stones were piled several deep around the base of a lodge structure and they gradually became disarranged through time. At the center of some are small piles or vague circles that suggest fire hearths. Some of these "fire hearths" are centrally located but many are not; some circles contain carefully prepared fire pits. Stones used may be stream boulders and cobbles or slabs of limestone, sandstone, or whatever other stone material was available.

These stone circles may represent all that remains after the removal or disintegration of various kinds of superstructures. If so they were constructed in conjunction with some sort of circular lodge or tipi (see Mulloy 1965a:48). Malouf (1961b) thinks that different-appearing structures may have disintegrated leaving similar-appearing stone circles. He favors a domestic or living structure origin for most of them. Malouf refers to all of these as "stone circles" but uses "tipi ring" if the circle was used to hold down the bottom of a skin-covered structure. Kehoe (1960) argues convincingly that the stone circles are actually tipi rings designed to hold down lodge covers but his data are limited to the Blackfoot reservation. Other ideas on the use and distribution of stone circles have been presented by Hoffman (1953). It appears that many stone circles do represent the only nonperishable remains of living structures but it can be strongly argued that others are not. Other less common features consist of vague stone circles made of large sandstone or limestone slabs. Certain kinds of dome-shaped, five- or six-sided, roughly circular log structures are known and may be Shoshonean in origin. Horizontally laid logs made up the sides of these structures and slabs of stone were laid around the outside. As the structure rotted away, the stones were left.

Stone circles believed to be of Crow Indian origin at the Piney Creek sites (Frison 1967b) have larger stone concentrations to the windward, suggesting a relatively long occupation (several weeks or more) with added stone for protection from strong winds that occur almost daily. Other Crow Indian tipi rings, identified as Crow on the basis of ceramics, are found above the timberline in several concentrations of a dozen or more in the northern Bighorn Mountains.

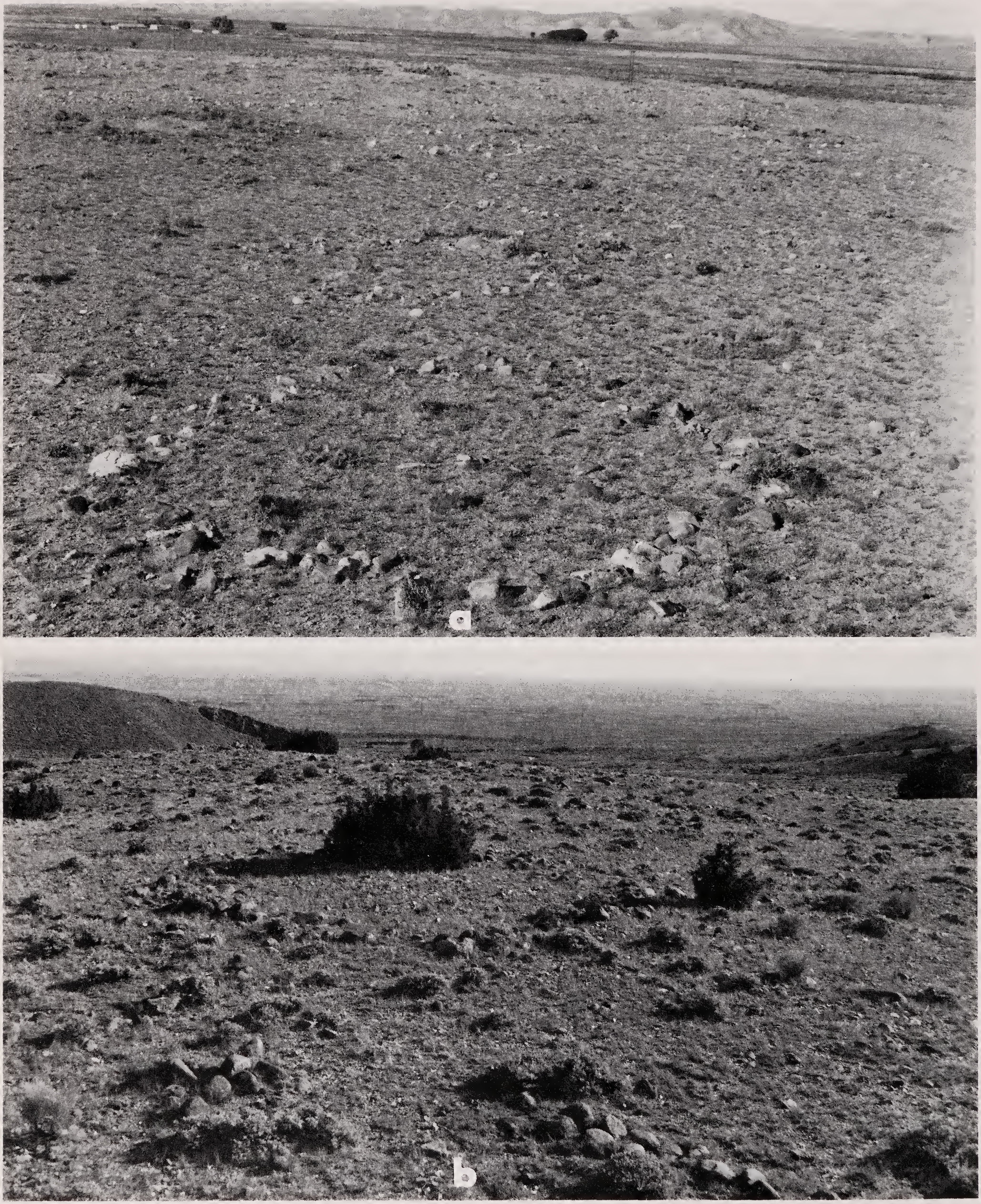


FIGURE 2.8. Stone circles on the Northwestern Plains. Two typical site locations on low butte tops in central Wyoming.

These are manifest as circles of large, angular limestone blocks and are deranged somewhat, suggesting that they had been placed on top of a lodge cover to hold it close to the ground and moved outward when the lodge was taken down. The fire hearths in many of the circles are centrally located, but in others they are outside the circle.

Stone circle sites are noted for a lack of diagnostic cultural material. Perhaps most of these sites, if they were living structures, represent occupations of a day or so. Most are associated with little more than a few flakes and an occasional broken projectile point or tool. It is possible that some circles had religious meaning; small stone circles have been observed in the vicinity of buffalo jumps and may represent locations of shamanistic activity associated with communal bison kills. Others are quite large and may have been built for the same kinds of reasons that present-day sheepherders build rock cairns and other features. On the other hand, many of the larger stone circles may have served important religious functions. Whatever their true function, stone circles will plague archeologists on the High Plains for some time to come.

Radiocarbon Dates for the McKean or Middle Plains Archaic Period

As mentioned in an earlier section, the name McKean is derived from the site by the same name in northeast Wyoming investigated by Mulloy (1954b). The McKean cultural level at the site was not radiocarbon dated. Sites nearby were investigated by Wheeler (n.d.) and these include Belle Rockshelter and Mule Creek Rockshelter. The former produced a radiocarbon date of about 1600 B.P. (C 667) on a McKean component and the latter produced a date of about 2800 B.P. (C 668) on a McKean component. The first date was rejected entirely by Wheeler and the second was considered too recent. Wheeler explained this latter case as possibly because of mixing charcoal from the three oldest site components. In the Angostura Reservoir area of northwestern South Dakota, Wheeler (n.d.) reported radiocarbon dates of about 3600 B.P. (M–368) and 4200 B.P. (M–369) on a McKean component at the Kolterman site.

Earliest known dates for the McKean Complex are those from the Bighorn Mountains area. Husted (1969) regards a date of 4900 B.P. (I–691) from the Sorenson site in southern Montana as a McKean date. If he is correct, the date is probably one of the earliest known for the complex. A date from Granite Creek Rockshelter in Shell Canyon (see Frison and Wilson 1975) not far from the Sorenson site is 4700 B.P. (RL–389), also quite early. The material used in dating at Granite Creek was recovered from a context in good association with lanceolate McKean projectile points.

At Signal Butte in western Nebraska (Forbis *et al.* n.d.; Strong 1935) radiocarbon dates derived from a level containing stemmed, lanceolate McKean and also large side-notched points radiocarbon dated at 4550 and 4170 B.P. (L–385B; L–385D). At the Scoggin site in central Wyoming (Lobdell 1973) a date of about 4500 B.P. (RL–174) was obtained from a fire pit associated with a bison kill containing both lanceolate and large, side-notched projectile points similar to those at Signal Butte.

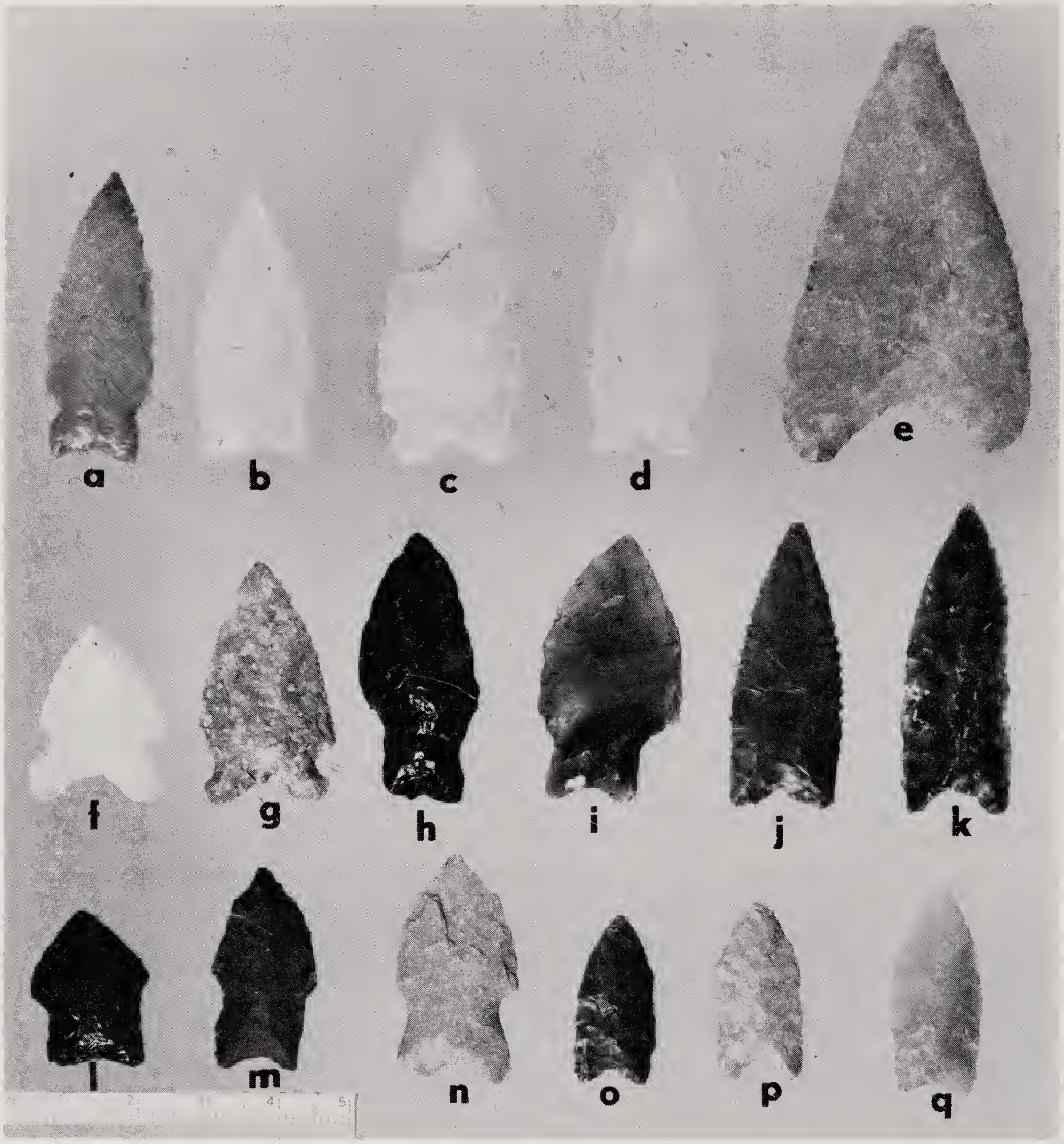


FIGURE 2.9. Projectile points of the McKean Complex from the Dead Indian Creek site.

The Dead Indian Creek site in northern Wyoming yielded three radiocarbon dates—4400, 4200, and 3800 B.P. (W–2599; W–2597; RL–321). The site is located in the Sunlight Basin, a small mountain basin adjacent to the west side of the Bighorn Basin. It was a winter camp location, reflecting extensive use of mule deer and lesser use of mountain sheep. All the known McKean projectile point variants were present (Figure 2.9). Winter occupation was determined by ageing of deer mandibles (Simpson 1974).

Mummy Cave, located close to the Dead Indian Creek site, produced a radiocarbon date of about 4400 B.P. (I–1428) on McKean artifacts (Wedel *et al.* 1968). The Medicine Lodge Creek site had a deep, stratified unit containing McKean cultural materials. The stratigraphic unit was interrupted by a river cobble level about 3 feet in thickness; McKean dates were derived from *in situ* cultural levels both above and below the cobbles. This indicates McKean occupations both before and after the stream flowed over the site. A radiocarbon date of just over 4000 B.P. (RL–438) came from below the cobbles; dates (in stratigraphic sequence) of about 4000 B.P. (RL–98) and about 3700 B.P. (RL–97; RL–442) were obtained above the level of river cobbles, all on McKean cultural materials including lanceolate, stemmed, and notched projectile point varieties. Close to the Medicine Lodge Creek site, Paint Rock V (a cave site already mentioned as yielding Paleo-Indian and Altithermal or Early Plains Archaic materials) provided a radiocarbon date of over 4300 B.P. (RL–482) on charcoal from a fire pit in a level with lanceolate and stemmed McKean projectile points. Leigh Cave, a few miles to the south of the Medicine Lodge Creek site, but still on the eastern side of the Bighorn Basin, yielded a date of nearly 4200 B.P. (Grey 1962; Grey laboratory No. 25) on stemmed McKean projectile points and small amounts of perishable materials including a wide variety of two-strand twisted cordage made with both milkweed and juniper bark fibers (Frison and Huseas 1968). On the eastern slopes of the southern Bighorn Mountains, a stratified cave site (48JO303) yielded McKean radiocarbon dates of over 3400 B.P. (A–483) and nearly 4000 B.P. (A–485) with both stemmed and side-notched projectile points (Haynes *et al.* 1966:17–18). Southsider Cave yielded two dates of about 3900 and 4200 B.P. (RL–668; RL–672) on McKean lanceolate projectile points (Figure 2.5d). Further east in western South Dakota, the Gant site (Gant and Hurt 1965) yielded a radiocarbon date of over 4100 B.P. (no lab number given). This site contained several of the variant styles of the McKean Complex. In southwestern Montana, the Myers–Hindman site (Lahren 1976) yielded radiocarbon dates on McKean cultural materials of over 3500 and 3100 B.P. (GaK2629 and GaK2630). The Dipper Gap site in northeastern Colorado (Metcalf 1973) is an extensive McKean site with a wide range of McKean projectile point variants. This site yielded three radiocarbon dates of over 3500, 3400, and nearly 3200 years ago (UGa–455; UGa–453; UGa–456).

Bison kills in the Powder River Basin have provided radiocarbon dates over a long period of Middle Plains Archaic time. The projectile points from these sites are believed to represent a single McKean variant. Locally, however, they are known as Yonkee points and are quite distinctive (see Chapter 5, Figure 5.32e–j). None of the other McKean projectile points are present. These sites have also produced the larger projectile point samples. A radiocarbon date of 4450 B.P. ± 125 (I–410) was obtained from charcoal in the Powers–Yonkee (or Yonkee) bison kill site in southeastern Montana (Bentzen 1961). A date of about 2900 B.P. (RL–162) was obtained from charcoal at Site 48SH312, an arroyo bison kill site along the Powder River in Wyoming close to the Montana line. (Projectile points at Site 48SH312 seem identical to those at the Yonkee site (Frison 1968c). Two radiocarbon dates of 2600 B.P. (I–644) and nearly 2500 B.P. (RL–160) are from charcoal at another arroyo bison kill, the Mavrakis-Bentzen-Roberts (or Buffalo Creek) site, located on a tributary of the Powder River about 25 miles east of Sheridan, Wyoming. Projectile points are similar to those from Powers-Yonkee and 48SH312 but do show some slight variation (Bentzen 1962). The possibility must be left open that these Powder River Basin bison kills represent cultural groups entirely separate from McKean.

These known dates on the McKean Complex with one exception indicate an end date of slightly before 3000 B.P. The exception is the Powder River Basin bison kill sites, which seem to have continuity for about another 500 years. The relationship between the so-called Yonkee site manifestations and the McKean Complex still needs to be clarified. Level II at the Kobold site (Frison 1970b) produced these same Yonkee style projectile points. One obsidian hydration date derived from this level was 4700 B.P. (hydration rate 5.5 μm^2/1000 years). The source of the obsidian is unknown and the date may not be reliable since the hydration rate for the obsidian used is not certain. Natural glass of nonvolcanic origin occurs in the Powder River Basin and source data are usable (Frison 1974a; Frison *et al.* 1968) but hydration rates are thought to be different than those from Yellowstone National Park obsidian sources that have been quite intensely studied.

The Late Middle Prehistoric or Late Plains Archaic Period

Late Plains Archaic period radiocarbon dates are listed in Tables 2.3–2.8 and 2.12. Site locations are shown in Figure 2.10.

Cultural materials, especially the projectile points, of the McKean Complex were replaced by later manifestations around 1000 B.C. in the Northwestern Plains. The first of these manifestations is a widespread cultural horizon over both the Northwestern Plains and the Northern Plains known as Pelican Lake. This horizon is identified by changes in projectile point types. Pelican Lake points are a true corner-notched type with wide, open notches that form sharp points as they intersect blade edges and bases. Both blade edges and bases may be straight or very slightly concave. They contrast sharply with earlier McKean types and appear to be the earliest of the corner-notched va-

FIGURE 2.10. Archeological sites of the Late Plains Archaic period. 1: Old Women's Buffalo Jump (Forbis 1962); 2: Head-Smashed-In Buffalo Jump (Reeves 1974); 3: Mortlach (Wettlaufer 1955); 4: Long Creek (Wettlaufer and Mayer-Oakes 1960); 5: Wahkpa Chu'gn 24HL101 (Davis and Stallcop 1966); 6: Keaster 24PH401 (Davis and Stallcop 1965); 7: Schmitt 24BW559 (Davis 1973); 8: Eagle Creek 24PA301 (Arthur 1966); 9: Sphinx 24PA508 (Lahren 1971); 10: Small Emigrant Kill 24PA309 (Arthur 1966); 11: Myers–Hindman 24PA504 (Lahren 1976); 12: Pictograph Cave 24YL1 (Mulloy 1958); 13: Kobold 24BH406 (Frison 1970b); 14: Mummy Cave 48PA201 (Husted and Edgar n.d.; Wedel *et al.* 1968); 15: Dead Indian II 48PA551 (unpublished); 16: Medicine Lodge Creek 48BH499 (Frison and Wilson 1975); 17: Spring Creek Cave 48WA1 (Frison 1965); 18: Daugherty Cave 48WA302 (Frison 1968a); 19: McKean 48CK7 (Mulloy 1954b); 20: Fulton 48WE302 (unpublished); 21: Ruby 48CA302 (Frison 1971a); 22: Birdshead Cave 48FR54 (Bliss 1950); 23: Wedding of the Waters Cave 48HO301 (Frison 1962); 24: Shoshone Basin 48FR5, 48FR33, 48FR34 (Mulloy 1954a); 25: Pine Spring 48SW101 (Sharrock 1966); 26: Muddy Creek 48CR324 (unpublished); 27: Bighorn Canyon 48BH206 (Husted 1969); 28: Lance Creek 48NO204 (Haynes 1968); 29: Patten Creek 48PL68 (Haynes *et al.* 1966); 30: North Platte River 48PL23, 48PL24 (Mulloy 1965a; Mulloy and Steege 1967); 31: Signal Butte (Strong 1935); 32: Magic Mountain (Irwin-Williams and Irwin 1966).

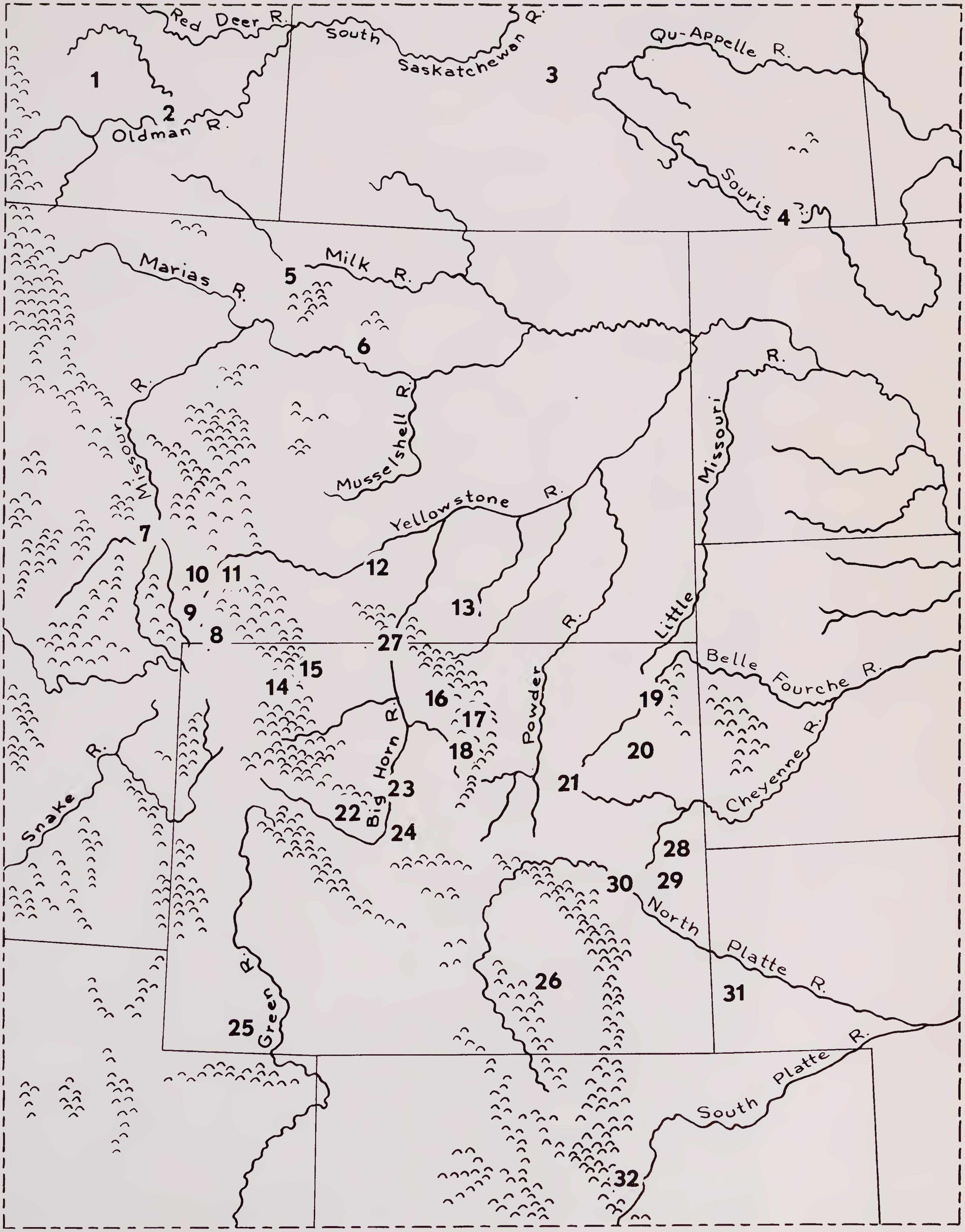

Red Deer R.
South Saskatchewan R.
Qu-Appelle R.
Oldman R.
Souris
Milk R.
Marias R.
Missouri R.
Musselshell R.
Yellowstone R.
Missouri R.
Little
Belle Fourche R.
Cheyenne R.
Powder R.
Big Horn R.
Snake R.
Green R.
North Platte R.
South Platte R.
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TABLE 2.12
Radiocarbon Dates of the Late Plains Archaic Period

Lab. No.	Date	Site
	Campsites and Quarries	
WSU–369	1230 ± 160 (A.D. 720)	Eagle Creek, Mont.
M–971	1325 ± 150 (A.D. 625)	48PL24, Wyo.
I–559	1525 ± 130 (A.D. 425)	48PL24, Wyo.
M–972	2020 ± 200 (70 B.C.)	48PL23, Wyo.
L–385A	2630 ± 100 (680 B.C.)	Signal Butte, Nebr.
GaK–1302	2170 ± 80 (220 B.C.)	Happy Hollow Rockshelter, Colo.
GaK–844	2680 ± 90 (730 B.C.)	Happy Hollow Rockshelter, Colo.
SI–530	1670 ± 100 (A.D. 280)	Rabbit Bone Cave, Wyo.
Grey No. 10	1620 ± 165 (A.D. 330)	Wedding of the Waters Cave, Wyo.
M–433	1725 ± 200 (A.D. 225)	Spring Creek Cave, Wyo.
RL–377	1760 ± 100 (A.D. 190)	48BH332, Wyo.
RL–441	1640 ± 120 (A.D. 310)	48BH332, Wyo.
I–8122	2380 ± 85 (430 B.C.)	Schmitt, 24BW559, Mont.
I–8121	2180 ± 95 (230 B.C.)	Schmitt, 24BW559, Mont.
C 711	3350 ± 250 (1400 B.C.)	48FR33, Wyo.
C 712	3506 ± 220 (1556 B.C.)	48FR5, Wyo.
C 702	3540 ± 220 (1590 B.C.)	48FR34, Wyo.
C 715	3287 ± 600 (1337 B.C.)	McKean, Wyo.
	Bison Kill Sites	
A–364	2450 ± 75 (500 B.C.)	Lance Creek, Wyo.
RL–350	2150 ± 150 (200 B.C.)	Fulton, Wyo.
RL–385	2040 ± 90 (90 B.C.)	Mooney, Wyo.
GX–1157	1670 ± 135 (A.D. 280)	Ruby, Wyo.
M–2348	1800 ± 140 (A.D. 150)	Ruby, Wyo.
RL–394	1720 ± 110 (A.D. 230)	Muddy Creek, Wyo.

rieties of the Late Plains Archaic. The name *Pelican Lake* comes from the designation given the lower levels of the Mortlach site in south-central Saskatchewan (Wettlaufer 1955). Similar material was described from the Long Creek site in extreme southeastern Saskatchewan (Wettlaufer and Mayer-Oakes 1960). Head-Smashed-In Buffalo Jump (Reeves 1974) was characterized by a number of radiocarbon-dated Pelican Lake levels (Table 2.10). Two Pelican Lake levels are dated at about 3000 and 3100 B.P. (RL–96; RL–559) at Medicine Lodge Creek. Both levels contained projectile points (see Chapter 5, Figure 5.40g–j). The dates compare well with those from Head-Smashed-In Buffalo Jump. Relatively large corner-notched dart points other than Pelican Lake persist on the Northwestern Plains until around A.D. 500.

Also found on the Northwestern Plains is a distinctive projectile point diagnostic of what Wettlaufer (1955) named the *Besant* culture; the name is derived from the Mortlach site in south-central Saskatchewan. Besant on the Northwestern Plains represents an extremely sophisticated bison hunting manifestation. Dates are known from the third century A.D. and are from bison corrals built of logs and posts set in deep postholes (see Frison 1971a). Evidence of religious activity is present at Besant sites on the Northwestern Plains. Large, side-notched, dart-type projectile points (see Chapter 5, Figure 5.40a–c, e, f), plus a few corner-notched points are diagnostic of Besant.

Radiocarbon Dates for the Late Middle or Late Plains Archaic Period

The oldest radiocarbon dates for the Late Middle or Late Plains Archaic period were derived from charcoal samples that were dated by the solid carbon or earlier method and may be open to question. These include the upper level of the McKean site in northeast Wyoming (Mulloy 1954b) which was dated at nearly 3300 B.P. (C 715). Three dates from sites in the Shoshone Basin (Mulloy 1954a) range from 3350 to 3540 years ago (C 711; C 712; C 702).

Mummy Cave produced two radiocarbon dates from cultural levels of the Late Plains Archaic. The earliest is about 2800 B.P. (I–1427) and the projectile points from the level are corner-notched and reminiscent of the Pelican Lake type with sharp corners at the junctures of the notch with the base and blade edges (Husted and Edgar n.d.). Another date from a more recent level is 2050 B.P. (I–1075). This level contained corner-notched points, but these have smaller notches and less-sharp corners at the juncture of base and blade edges with the notch. At the Medicine Lodge Creek site a good sample of Pelican Lake projectile points was recovered in a late level dated at 3000 and 3100 B.P. (RL–96; RL–559). The Schmitt site 24BW559 (Davis 1973) near Three Forks, Montana, is a large quarry site worked during the Pelican Lake period; radiocarbon dates are about 2400 and 2200 B.P. respectively (I–8122; I–8121). Higher levels in the Medicine Lodge Creek site yielded dates of about 1800 and 1600 B.P. (RL–440 and RL–95) on corner-notched dart points. A dry rockshelter (48BH332) a short distance from the Medicine Lodge Creek site was dated at 1760 B.P. (RL–377) and 1640 B.P. (RL–441). Both dates were for corner-notched dart points, and the points given the latter date were found in direct context with coiled basketry fragments and small amounts of other perishable material.

A number of radiocarbon-dated cave and rockshelter sites suggest a relatively intense occupation in the Bighorn mountain and basin areas from about A.D. 200 to A.D. 500. Spring Creek Cave on the western slopes of the Bighorn Mountains provided a large collection of perishable material of the Late Plains Archaic period. This included coiled basketry fragments; extensive debris from woodworking; bark cordage; sinew; hide; feathers; shell; and many other items along with corner-notched projectile points. Atlatl fragments (Figure 2.11e, f) and a nearly complete atlatl (Figure 2.11g) were recovered, along with atlatl weights, mainshaft fragments (Figure 2.11d), and a number of foreshafts. One corner-notched projectile point was mounted with sinew and pitch on a foreshaft (Figure 2.11a) and a number of broken specimens (Figure 2.11b) and partially mounted specimens were recovered (Frison 1965). Another large body of identical perishable material was recovered from Daughterty Cave (Frison 1968a) but this site was not radiocarbon dated. Similar dated material was recovered, however, from Wedding of the Waters Cave (Frison 1962) and the cultural materials included several sharpened wooden foreshafts (Figure

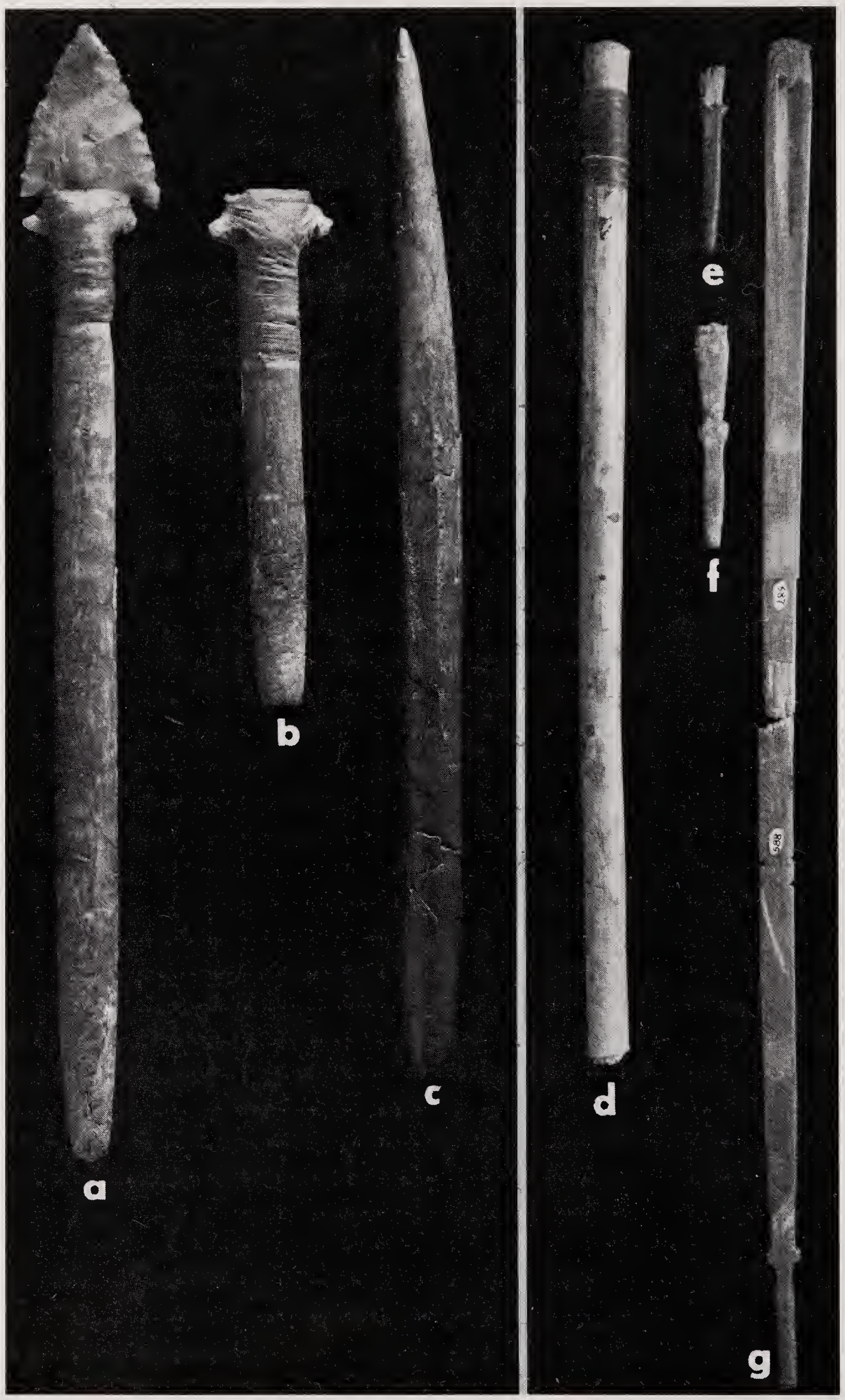


FIGURE 2.11. Projectile points and foreshafts (a, b), part of a mainshaft (d), and atlatl fragments (e, f) and atlatl (g) from Spring Creek Cave. Wooden foreshaft with sharpened point (c) from Wedding of the Waters Cave.

2.11c). Occupation V at Bottleneck Cave in Bighorn Canyon in Wyoming (Husted 1969) apparently dates corner-notched projectile points. Corner-notched points were recovered from Rabbit Bone Cave in the northwestern part of the Bighorn Basin near Cody, Wyoming (Stuckenrath and Mielke 1972). Radiocarbon dates include M–433, Grey No. 10, SI–238, and SI–530.

One of the Besant bison kill sites, the Ruby site (Frison 1971a), in the eastern Powder River Basin, near the Pumpkin Buttes south of Gillette, Wyo-

TABLE 2.13
Radiocarbon Dates of the Late Prehistoric Period

Lab. No.	Date	Site
	Bison Kills	
WSU–651	<250 Years ago	Eagle Creek, Mont.
M–1747	340 ± 100 (A.D. 1610)	Piney Creek, Wyo.
M–1748	370 ± 100 (A.D. 1580)	Piney Creek, Wyo.
M–1859	450 ± 110 (A.D. 1500)	Big Goose Creek, Wyo.
M–1860	530 ± 110 (A.D. 1420)	Big Goose Creek, Wyo.
M–2350	210 ± 100 (A.D. 1740)	Glenrock Buffalo Jump, Wyo.
M–2349	280 ± 100 (A.D. 1670)	Glenrock Buffalo Jump, Wyo.
RL–172	<230 Years ago	Vore Buffalo Jump, Wyo.
RL–173	200 ± 90 (A.D. 1750)	Vore Buffalo Jump, Wyo.
RL–349	370 ± 140 (A.D. 1580)	Vore Buffalo Jump, Wyo.
RL–161	480 ± 100 (A.D. 1470)	Foss-Thomas, Mont.
RL–103	990 ± 100 (A.D. 960)	Wardell, Wyo.
RL–111	1170 ± 100 (A.D. 780)	Wardell, Wyo.
RL–102	1580 ± 110 (A.D. 370)	Wardell, Wyo.
	Campsites and Burials	
Grey No. 26	450 ± 141 (A.D. 1500)	Nine-Mile-Creek Hearth, Wyo.
Grey No. 12	365 ± 138 (A.D. 1585)	Joe Emge, Wyo.
RL–101	230 ± 100 (A.D. 1720)	Eden–Farson, Wyo.
A–583	670 ± 160 (A.D. 1280)	Turk Burial, Wyo.
A–548	900 ± 240 (A.D. 1050)	PK Burial, Wyo.
M–973	1025 ± 150 (A.D. 925)	48PL29, Wyo.
RL–453	1080 ± 180 (A.D. 870)	Lummis, Wyo.
RL–472	1130 ± 110 (A.D. 820)	Lummis, Wyo.
RL–387	1230 ± 90 (A.D. 720)	Granite Creek Rockshelter, Wyo.
RL–471	780 ± 110 (A.D. 1170)	48CR310, Wyo.
Gak–1303	1270 ± 80 (A.D. 680)	Happy Hollow Rockshelter, Colo.
GaK–1304	780 ± 90 (A.D. 1170)	Happy Hollow Rockshelter, Colo.
A–1273	930 ± 230 (A.D. 1020)	T–W Diamond, Colo.
A–1274	780 ± 220 (A.D. 1170)	T–W Diamond, Colo.
A–1272	1550 ± 340 (A.D. 400)	T–W Diamond, Colo.
Gulf Oil Co.	1020 ± 86 (A.D. 930)	Lee, Wyo.
RL–383	1440 ± 100 (A.D. 510)	48BH334, Wyo.
RL–538	1400 ± 100 (A.D. 550)	Beehive, Wyo.
RL–704	1750 ± 110 (A.D. 200)	Greyrocks site, Wyo.

ming, has two radiocarbon dates. One (GX–1157) is from the bone level; the other (M–2348) is from an unidentified cultural level below this. The other Besant bison kill is about 100 miles south of the Ruby site on upper Muddy Creek (which is on the North Platte River drainage) and a radiocarbon date on charcoal from this site is about 1700 B.P. (RL–394).

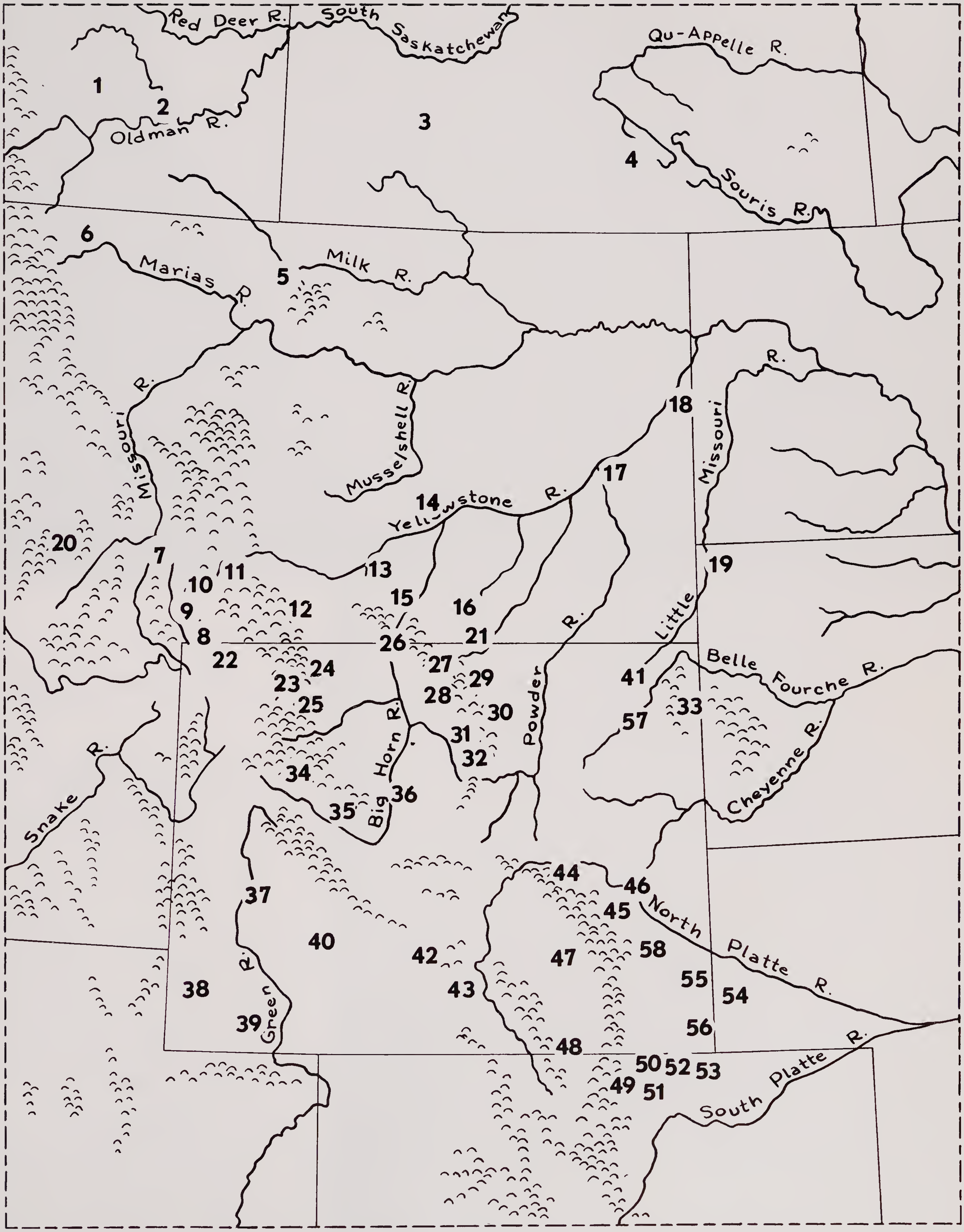
The Late Prehistoric Period

Late Prehistoric period radiocarbon dates are listed in Tables 2.3–2.6, 2.8, and 2.13. Site locations are presented in Figure 2.12.

The Late Prehistoric period is believed to have begun around A.D. 500. Typologically it is recognized by a change in projectile point types and sizes resulting from the introduction of the bow and arrow. Most but not all the projectile points of the period in the area are side-notched. Apparently some of the corner-notched dart points were simply reduced in size for use with the bow. Serrated blade edges were a common addition also.

The earliest of the late side-notched projectile points seem to have appeared first on the Northern Plains and were given the name of Avonlea from a site in Saskatchewan (Kehoe and McCorquodale 1961). They are characterized

FIGURE 2.12. Archeological sites of the Late Prehistoric period. 1: Old Women's Buffalo Jump (Forbis 1962); 2: Head-Smashed-In Buffalo Jump (Reeves 1974); 3: Gull Lake (Kehoe 1973); 4: Avonlea (Kehoe and McCorquodale 1961); 5: Wahkpa Chu'gn 24HL101 (Davis and Stallcop 1966); 6: Boarding School 24GL302 (Kehoe 1967); 7: Madison (Logan) Jump (Malouf 1962); 8: Eagle Creek 24PA301 (Arthur 1966); 9: Sphinx 24PA508 (Lahren 1971); 10: Large Emigrant Jump 24PA308 (Arthur 1962; Brown 1932); 11: Myers–Hindman 24PA504 (Lahren 1976); 12: Keogh Jump 24ST401 (Conner 1962b); 13: Pictograph Cave 24YL1 (Mulloy 1958); 14: Thirty-Mile Mesa (Mulloy 1965b); 15: Grapevine Jumps (Medicine Crow 1962a); 16: Kobold 24BH406 (Frison 1970b); 17: Ash Coulee 24PE118 (Mulloy 1953); 18: Hagen 24DW2 (Mulloy 1942); 19: Ludlow Cave (Over 1936); 20: LaMarche Game Trap 24BE1011 (Keyser 1974); 21: Foss-Thomas (Fry 1971); 22: Yellowstone Park Wickiups 48YE2 (Shippee 1971); 23: Mummy Cave 48PA201 (Wedel *et al.* 1968); 24: Dead Indian III 48PA551 (this volume); 25: Logan Mountain Lodges 48PA57 (this volume); 26: Bighorn Canyon Caves 24CB221, 24BH253, 24CB202 (Husted 1969); 27: Medicine Wheel 48BH302 (Eddy 1974; Grey 1963a); 28: Medicine Lodge Creek 48BH499 (Frison and Wilson 1975); 29: Big Goose Creek 48SH313 (Frison 1967a); 30: Piney Creek 48JO311, 48JO312 (Frison 1967b); 31: Ten Sleep Creek 48WA305 (Frison 1967a); 32: Daughtery Cave 48WA302 (Frison 1968a); 33: Vore Buffalo Jump 48CK302 (Reher and Frison, n.d.); 34: Dubois Animal Traps 48FR307, 44FR309 (this volume); 35: Birdshead Cave 48FR54 (Bliss 1950); 36: Wedding of the Waters Cave 48HO301 (Frison 1962); 37: Wardell 48SU301 (Frison 1973b); 38: Bridger Antelope Trap 48UT1 (this volume); 39: Pine Spring 48SW101 (Sharrock 1966); 40: Eden–Farson 48SW304 (Frison 1971b); 41: Missouri Buttes Antelope Trap 48CK49 (this volume); 42: Green Mountain War Lodge (this volume); 43: John Gale 48CR303 (Brox and Miller 1974); 44: Glenrock Buffalo Jump 48CO304 (Frison 1970a); 45: Irvine 48CO302 (Duguid 1968); 46: North Platte 48PL29 (Mulloy and Steege 1967); 47: Shirley Basin 48AB301 (Zeimens 1975); 48: Willow Springs Buffalo Trap 48AB302 (this volume); 49: Roberts Buffalo Jump 5LR100 (Witkind 1971); 50: Wilbur Thomas 5WL45 (Breternitz 1971); 51: T–W Diamond 5LR200 (Flayharty and Morris 1974); 52: Happy Hollow 5WL101 (Steege 1967); 53: Agate Bluff (C. Irwin and H. Irwin 1957); 54: Signal Butte (Strong 1935); 55: Gurney Peak Butte 48LA305 (Reher 1971); 56: Seven-Mile Point 48LA304 (Reher 1971); 57: Miller Creek 48CK47 (Crane 1956; Wheeler n.d.); 58: Greyrocks site 48PL65 (Zeimens and Walker 1977).


Red Deer R.
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Cheyenne R.
Powder R.
Big Horn R.
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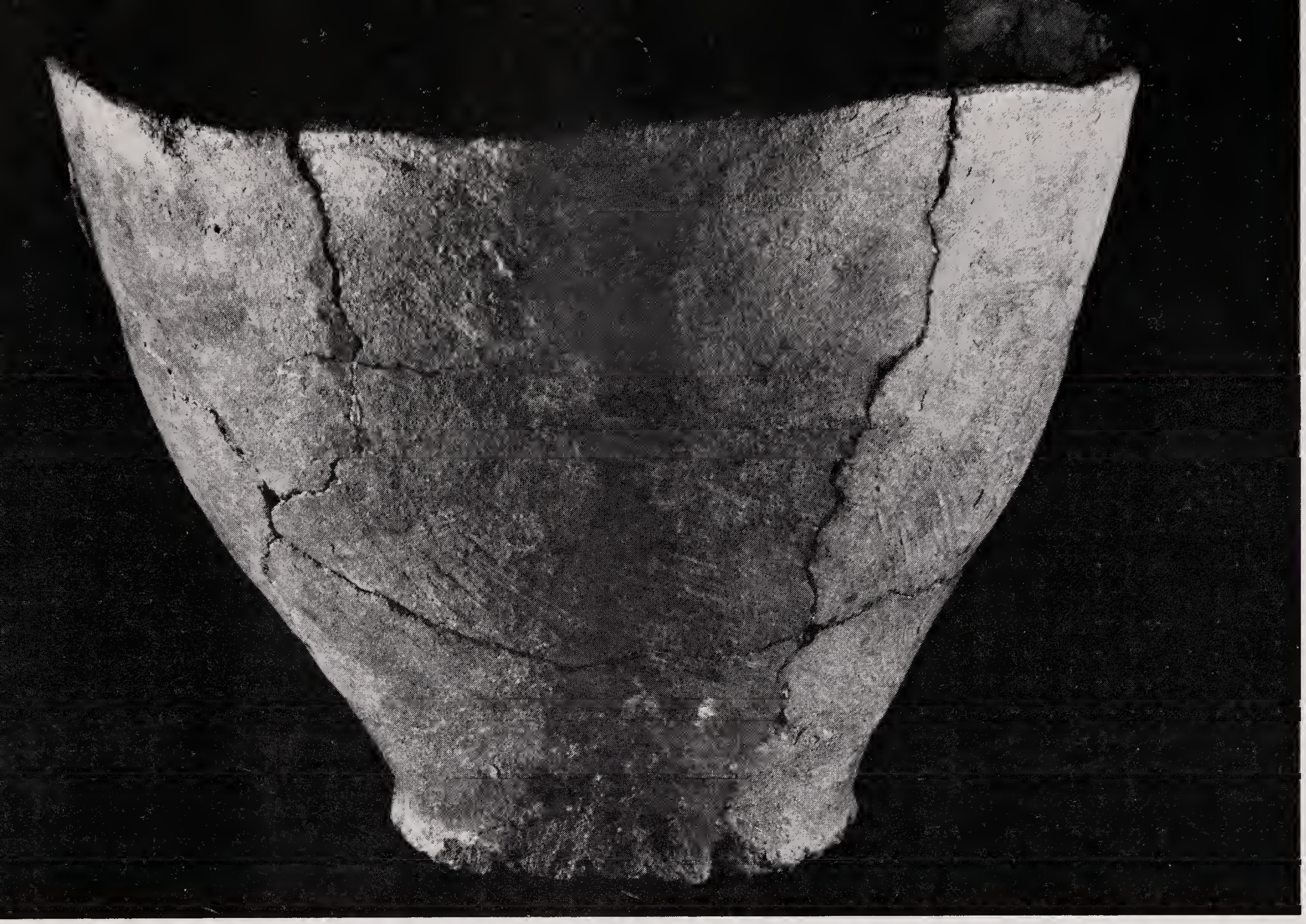


FIGURE 2.13. Intermountain Tradition fired vessel from southwestern Wyoming.

by true side-notches placed close to the base. The cultural relationships between Avonlea in the north and similar-appearing projectile point assemblages on the Northwestern Plains is unclear.

Both the small corner-notched and the side-notched bow and arrow projectile points occur at about the same time; together they reflect a number of different cultural groups. Side-notching and base-notching together on small bow and arrow points appeared toward the end of the Late Prehistoric period and was common in protohistoric times on the Northwestern Plains.

Pottery also appeared on the Northwestern Plains during the Late Prehistoric period. Although present in relatively small amounts, it is a valuable cultural marker. Several pottery traditions are represented. However, with one exception, the different pottery-bearing peoples were intrusive or at least peripheral to the centers of main development and we are forced to deal with somewhat degenerate ceramic assemblages. The exception is the Intermountain Pottery Tradition (Mulloy 1958), usually regarded as having cultural affiliations with Shoshonean groups. Although it appears indigenous to the Northwestern Plains its original source may have been elsewhere.

Shoshonean or Intermountain Tradition pottery is recognizable by a distinctive flat bottom and usually a flowerpot shape (Figure 2.13) with a flanged base, although a number of stylistic variations are now known (see Frison 1971b; Wedel 1954). The technology is generally poor in relation to other ceramics. The pottery is usually thick and poorly fired, and it contains ungraded tempering materials of widely varying sizes. Surface treatment is usually nothing more than a poorly executed smoothing. Holes drilled on both sides of a break for patching are also common, and small segments of vessels were reworked for reuse. It was common to make a smaller vessel out of a larger one by grinding a groove around a vessel for whatever distance was necessary below the rim to avoid a break. The vessel could then be broken along the groove and the lower part salvaged.

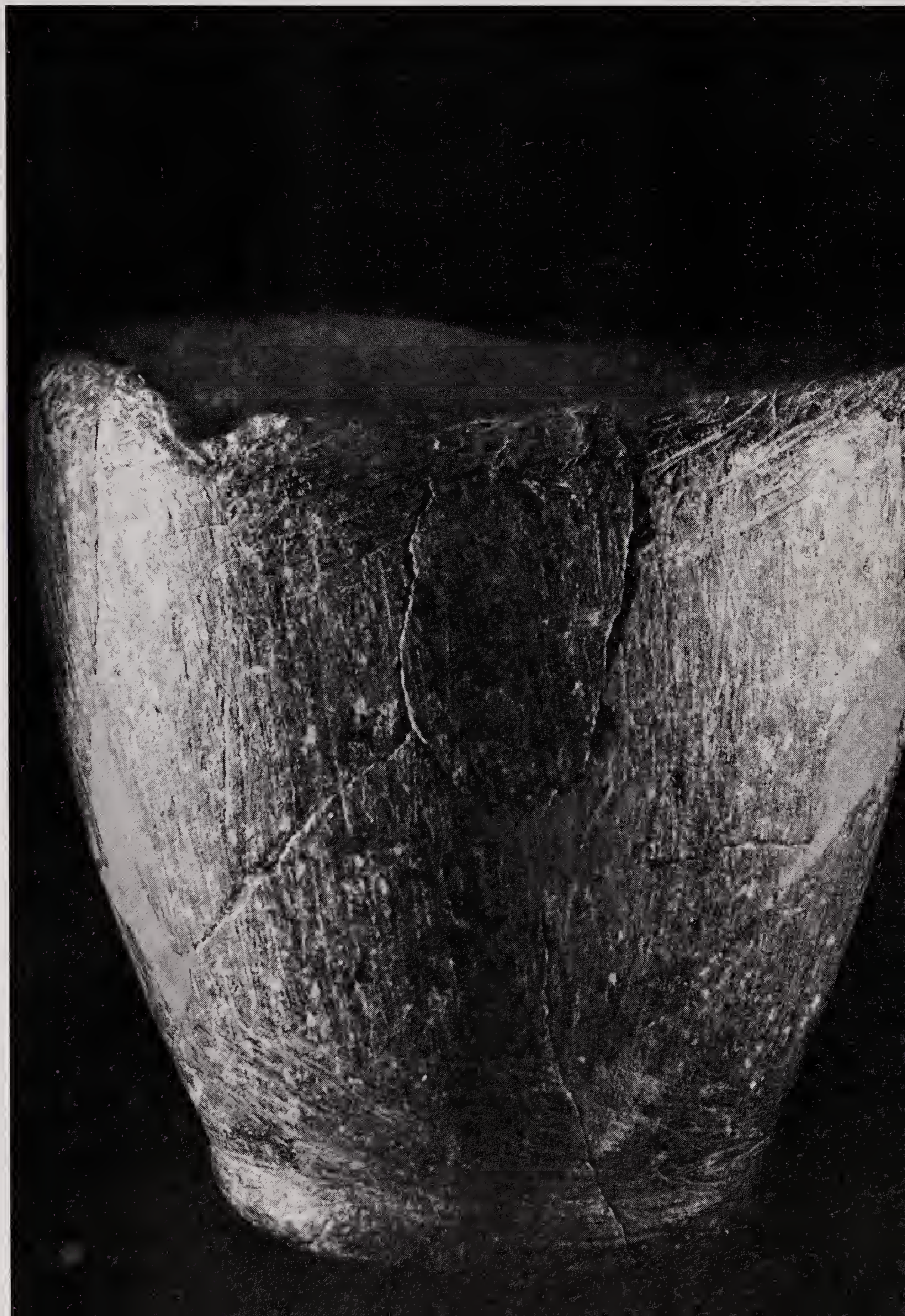


FIGURE 2.14. Carved steatite vessel from Wyoming.

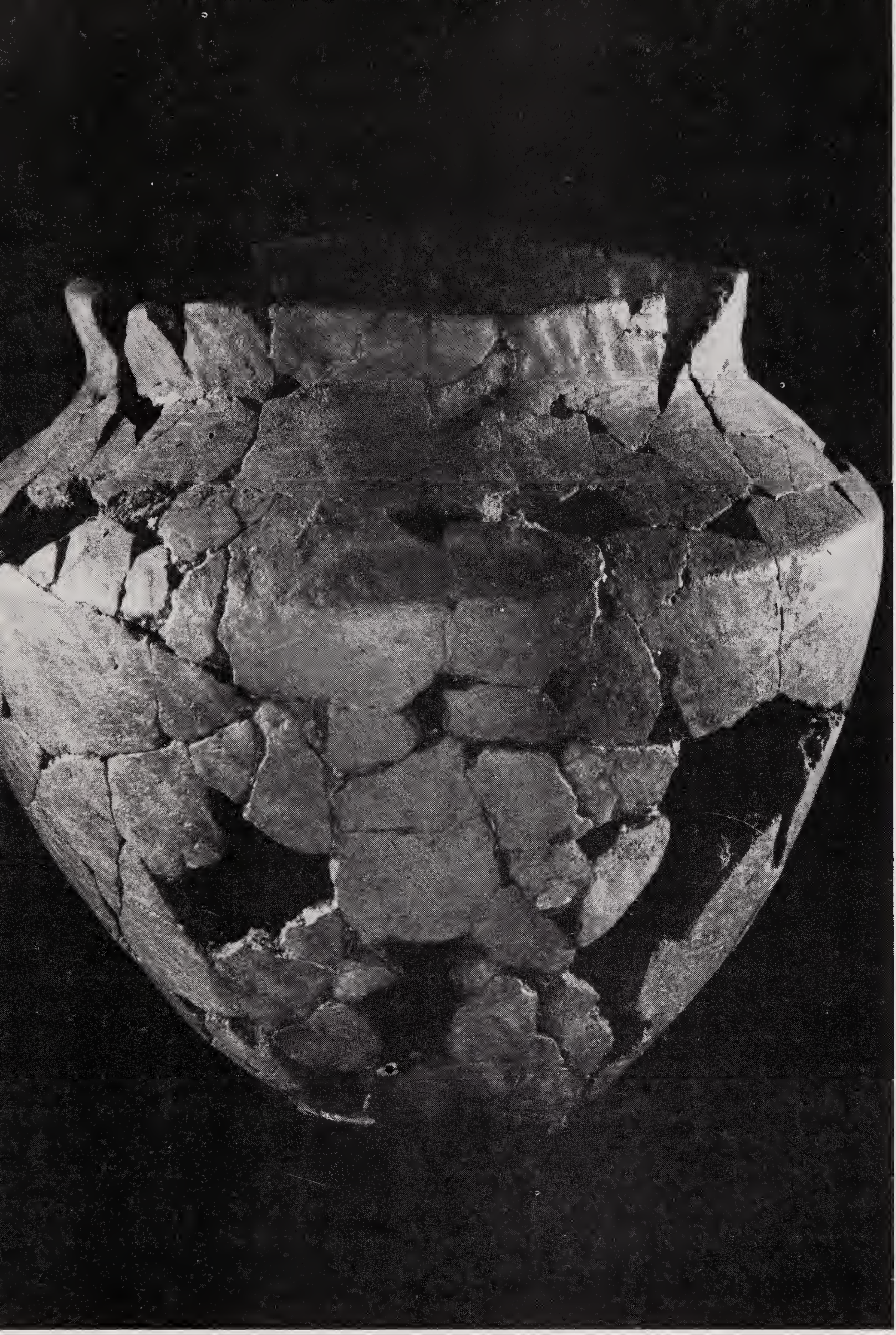


FIGURE 2.15. Probable Crow vessel from northern Wyoming.

Along with pottery, carved steatite vessels in the same flat, flanged-base, flowerpot style (Figure 2.14) were common. Steatite sources are found in the Teton, Wind River, and Bighorn mountains and all these sources demonstrate extensive quarrying operations. The steatite is extremely heavy and vessel blanks are a common find where they were cached at distances from the quarries. We are still not sure which came first, the fired pottery or the carved steatite; neither are we sure of the time depth of the two. Radiocarbon dates are known for this pottery. The oldest (GaK–2631) is from Myers–Hindman (Lahren 1976). Others (I–1074, RL–101, WSU–651) are from Mummy Cave (Husted and Edgar n.d.), Eden–Farson (Frison 1971b), and Eagle Creek (Arthur 1966) and are much later. The characteristic flat-bottomed pottery and carved steatite vessels occur all over the area but seem to increase in frequency to the north and west expecially in the Green River Basin, the Upper Snake River drainage, the Absaroka Mountains and upper Yellowstone River drainages.

Mandan Tradition pottery occurs from the northeast quarter of Wyoming to southern Montana and northwestern South Dakota. It is believed this pottery (Figure 2.15) was left by Crow Indians (see Frison 1967a) although the exact nature of the Crow Indian movements to the Plains and their subsequent occupation of the area is still not yet well known. It now appears that there may have been several movements of the Crow to the area over a period of several hundred years.

Most Crow pottery is quite distinctive in shape, decorative motif, and technology. On the other hand, sites that produce adequate samples for positive identification are rare. Shoshonean and Crow pottery often occur together in the same campsite and this has been postulated as the result of one cultural group stealing women from the other. Several complete and reconstructed Crow vessels have been collected and described (Frison 1976b). What is believed to be Crow pottery has appeared in places along the Yellowstone River in Montana (Mulloy 1942, 1953, 1958) and in extreme northwestern South Dakota (Over 1936).

Woodland pottery is found on the eastern edge of the area along the Wyoming–Nebraska border and in northeastern Colorado. An isolated occurrence of Woodland pottery was noted in southern Montana just north of Sheridan, Wyoming, and is apparently in good context but has not yet been radiocarbon dated. A nearly complete Woodland vessel (Figure 2.16) was recovered near Wheatland, Wyoming at the Greyrocks site (48PL65) in good cultural context with a date of about 1750 B.P. (RL–704) Wheeler (n.d.) found Woodland pottery at Mule Creek Rockshelter (48CK4) in northeast Wyoming. Woodland pottery was also found in extreme northern Colorado at the Happy Hollow Rockshelter (Steege 1967).

A pottery occurrence in the Green River Basin in a camp associated with a bison corral kill site has not been resolved. The shape of a partially restored vessel is vaguely suggestive of Woodland but the surface treatment is not. I have suggested possible Athabascan relationships but this remains to be proven (Frison 1973b).

Upper Republican Tradition pottery occurs within the loop of the North Platte River in Wyoming. Other occurrences are on the eastern Colorado Plains and in western Nebraska. Flat-bottomed pottery suggestive of Intermountain has been recorded in sites containing Upper Republican ceramics but the contexts were not good enough to determine whether these were the results of the same or different occupations, and none of the sites have been radiocarbon dated.

Pueblo pottery, both corrugated and painted sherds, has been found along the southern border of Wyoming west of the North Platte River. These sherds have not yet occurred in datable contexts or in association with diagnostic materials. Small amounts of Fremont pottery have been found in southwestern Wyoming close to the Green River but only as surface finds. The occurrence of

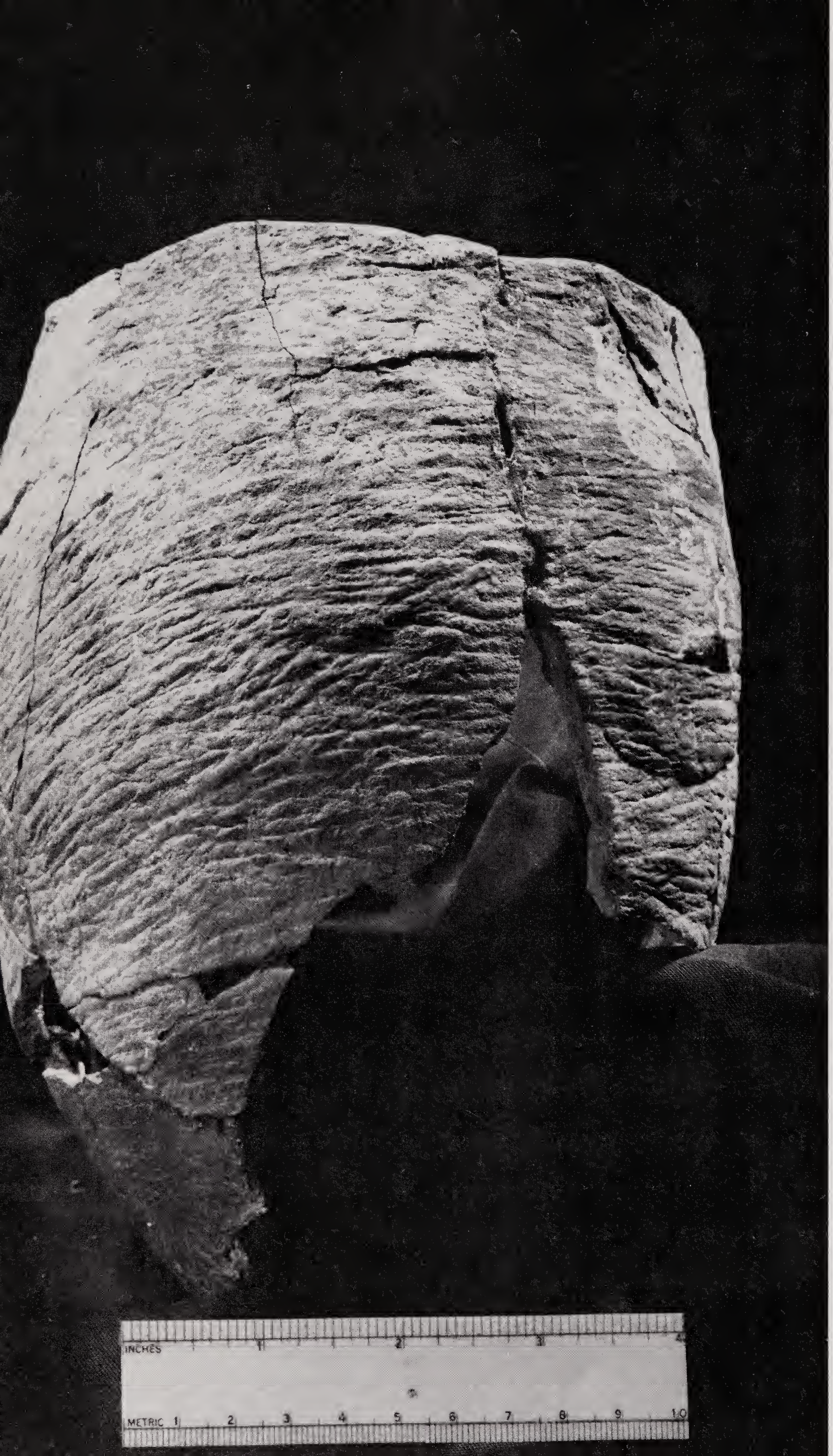


FIGURE 2.16. Plains Woodland vessel from eastern Wyoming.

Dismal River and Promontory pottery in Wyoming is still questionable although occasional sherds from the southeastern part of the state do demonstrate Dismal River characteristics.

The Northern Plains are in about the same stage of progress as the Northwestern Plains with regard to ceramic studies. Griffin (1965) reviewed pottery complexes in Alberta, Saskatchewan, and northern Montana. Kehoe (1959) described three prehistoric or protohistoric pottery traditions for the Northern and Northwestern Plains. Johnson (1977) describes pottery in northern Montana. All these studies may eventually reveal some relationships with areas further to the south.

Other items diagnostic of the Late Prehistoric period on the Northwestern Plains are the grooved maul and the bison metatarsal flesher. These are so widespread, however, that specific tribal identifications from them are not possible.

Radiocarbon Dates for the Late Prehistoric Period

The earliest known radiocarbon dates on Late Prehistoric period deposits containing the late side-notched types of projectile points on the Northwestern Plains are from the Wardell site (Frison 1973b), a large bison kill and campsite near Big Piney in western Wyoming along the Green River. Radiocarbon dates are from about 1000 to 1600 B.P. (RL–103; RL–102; RL–111) and were taken from both kill and butchering–campsite locations. Obsidian dates (Friedman, personal communication 1974) tend to uphold the validity of the radiocarbon dates. The site area is not far from obsidian quarry sources in Yellowstone National Park and in the Teton Pass area. A large sample of side-notched projectile points was recovered from three stratigraphic units at the site. Pottery of a controversial type was recovered. In outline form a reconstruction of a single vessel demonstrates a slight shoulder with a pointed bottom, vaguely suggesting some connection with Plains Woodland ceramics. The radiocarbon and obsidian hydration dates, if correct, would be about right for this kind of cultural affiliation. Some of the projectile points are reminiscent of the Avonlea type but others are quite different. A possible Athabascan association has been suggested on the basis of the ceramics. Earlier radiocarbon dates than those at Wardell are known for Avonlea and Head-Smashed-In Buffalo Jump in Alberta provides a good range for these dates (Reeves 1974) (Table 2.10).

Both the Late Prehistoric period side-notched and corner-notched projectile points occurred together in Occupation VI of the Sorenson site in Bighorn Canyon; the site yielded a radiocarbon date of about 1300 B.P. (I–690). The side-notched variety is regarded as possible Avonlea by the investigator (Husted 1969) and the two types could represent separate occupations by different cultural groups within a short time. The same investigator found Avonlea projectile points at the Bill Greene site in the same Bighorn Canyon area; the radiocarbon date was similar (SI–103). Occupation III of the Mangus site (24CB221) in the same area yielded two radiocarbon dates of over 1000 B.P. (SI–99; SI–100) on what may be Avonlea side-notched projectile points (Husted 1969).

The Lee site is a stratified, multicomponent site south of Kaycee, Wyoming, in the topographically rough breaks along the South Fork of the Powder River (Randall 1963). A level with side-notched points was dated at just over 1000 B.P. (Gulf Oil Company date). Similar projectile points and a date (M–973) were recovered at Site 48PL29 along the North Platte River at the Glendo Reservoir site (Mulloy and Steege 1967).

Late Plains side-notched projectile points were found at the Myers–Hindman site in an occupation level radiocarbon dated at just under 800 B.P. (Gak-2631). Both small corner-notched and side-notched varieties were found in a context having an almost identical date (RL–471) from an unpublished site salvaged on a pipeline survey north of Rawlins, Wyoming (48CR310). A radiocarbon date on a cultural level at the Happy Hollow Rockshelter (Steege 1967) south of Cheyenne, Wyoming, in extreme northern Colorado in association with Upper Republican ceramics and side-notched points is 780 B.P. ± 90 (Gak–1304). This seems an acceptable date for an Upper Republican occupation (see Wedel 1961).

Several radiocarbon dates are from cultural levels in sites containing Crow ceramics and both side-notched and side-notched, base-notched projectile points. The earliest dates are around 400 to 500 B.P. (M–1859; M–1860) from a winter campsite at the base of the Bighorn Mountains west of Sheridan, Wyoming, along Big Goose Creek (Frison 1967a). About 30 miles south of Big Goose Creek is the Piney Creek site, a buffalo jump, butchering area, and campsite that has been radiocarbon dated at about 100 years later (M–1747; M–1748) (Frison 1967b). As at the Big Goose Creek site, Crow pottery and side-notched and side-notched, base-notched projectile points were associated at Piney Creek. A Crow component with a similar artifact assemblage (except that the pottery was check-stamped) was excavated at the Medicine Lodge Creek site and is radiocarbon dated at just over 200 B.P. (RL–378).

Several other radiocarbon dates are from sites yielding late Plains side-notched projectile points but no ceramics. The Foss-Thomas site (Fry 1971) near Decker, Montana, is a small bison pound or corral in the form of a fenced area at the base of a low drop-off. A radiocarbon date of about 500 B.P. (RL–161) was obtained from a fire pit inside the pound; a large sample of projectile points without base notches was recovered. The Glenrock Buffalo Jump (Frison 1970a) near Glenrock, Wyoming, yielded two radiocarbon dates of between 200 and 300 B.P. (M–2349; M–2350) on side-notched projectile points. Several hundred years of buffalo jumping took place at the Vore Buffalo Jump near Sundance in the Wyoming Black Hills. The lowest level, at a depth of 17 feet, is radiocarbon dated at nearly 400 B.P. (RL–349). This level and several just above it produced side-notched projectile points lacking base notches. The next highest radiocarbon-dated level is at the 9-foot depth and yields a date of 200 B.P. (RL–173). Base-notching is not present at this level but appears immediately above the level. The top level at the site, at the 4-foot depth, has a radiocarbon date of less than 230 years ago (RL–172) and here and immediately below are long, narrow, side-notched, base-notched points, often with straight or slightly convex blade edges; there are also similar-shaped points lacking both side and base notches.

Radiocarbon dates were obtained from two sites that contained side-notched and side-notched, base-notched projectile points and Intermountain Tradition (Shoshonean) pottery. Mummy Cave (Husted and Edgar n.d.) yielded a radiocarbon date of 370 B.P. ± 90 (I–1074) and the Eden–Farson site (Frison 1971b) yielded a radiocarbon date of 230 B.P. ± 100 (RL–101).

Small corner-notched projectile points have been recorded throughout the Late Prehistoric period. At the Medicine Lodge Creek site and, in fact, throughout the entire Bighorn Mountain area they are associated with distinctive deep roasting pits lined with slabs of sandstone or limestone. In many cases the pits are surrounded with fire-fractured stones cleaned out of the pits after use. A level with small corner-notched points at the Medicine Lodge Creek site yielded a radiocarbon date of about 1400 B.P. (RL–376). A nearby cave site also yielded a radiocarbon date of about 1400 B.P. (RL–383). Projectile points are lacking from this site but identical slab-lined roasting pits are present. The slab-lined roasting pits may be a reliable horizon marker for the area. A date of about 1200 B.P. (RL–387) was obtained from the Granite Creek Rockshelter (Frison and Wilson 1975) on similar corner-notched projectile points.

A distinctive corner-notched projectile point that is long and narrow with serrated blade edges appeared at cultural layer 36 in Mummy Cave (Husted and Edgar n.d.) and was given the type name of *Wapiti Corner-Notched* (from a local place name). The level was radiocarbon dated at about 1200 B.P. (I–1009) and probably represents some Late Prehistoric period Shoshonean cultural group.

At Happy Hollow Rockshelter in extreme northern Colorado (Steege 1967), Woodland pottery in context with small corner-notched projectile points was radiocarbon dated at about 1300 B.P. (GaK–1303). Two radiocarbon dates, each of about 1100 B.P. (RL–472; RL–453) were obtained from cultural levels having small corner-notched points and what may possibly be Woodland pottery. The site, known as the Lummis site, is located on the outskirts of Cheyenne, Wyoming (Zeimens *et al.* n.d.).

A burial in the southern Bighorn Mountains containing small corner-notched projectile points with serrated blade edges gave a radiocarbon date of nearly 700 B.P. (A–583; Grey 1963b). Another burial, further north at the base of the Bighorn Mountains, also contained small corner-notched projectile points and yielded a date of 900 B.P. (A–548; Bass and Lacy 1963).

A little-known cultural manifestation of the Late Prehistoric period, widespread over the mountain and foothill areas of northern Wyoming and southern Montana, is characterized by small, thin, delicately made projectile points with a wide range of notching styles (Figure 2.17). One radiocarbon date of around 1400 B.P. (RL–538) has been obtained. Campsites are especially common to butte tops and rims along deep canyons and contain large amounts of faunal material compared to sites of the preceding Late Plains Archaic period. Faunal materials include bison, deer, mountain sheep, and many smaller animals. Cultural assemblages are rich in small stone and bone tools. On the basis of present data, these sites appear unrelated to the ones with similar dates and slab-lined fire pits mentioned above.

Radiocarbon dates that clearly indicate the continuation of a true hunting

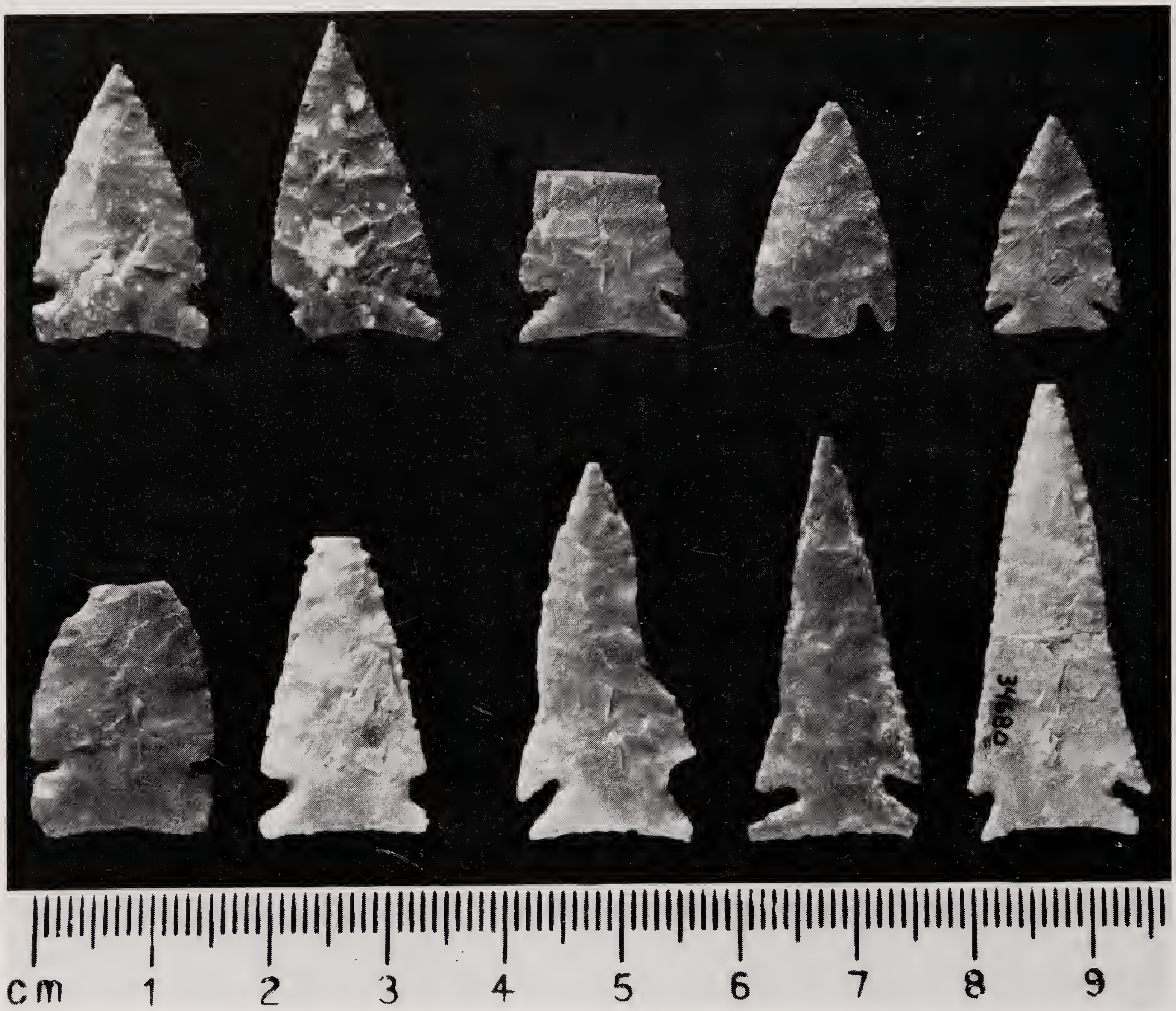


FIGURE 2.17. Projectile points representative of a little-known Late Prehistoric complex in northern Wyoming and southern Montana. All are from sites in northern Wyoming (48BH346; 48BH333) close to the Medicine Lodge Creek site.

and gathering economic orientation up to protohistoric times were obtained in two sites. Roasting pits from sites in the Bighorn and Powder River Basins yielded dates of 365 B.P. ± 138 (Grey 1962; Grey laboratory No. 12) and 450 B.P. ± 141 (Grey 1962; No. 26). No projectile points were found in association but the former site yielded both sandstone grinding slabs and mano stones in direct association with a number of roasting pits that appear to be identical to those of the Middle and Late Plains Archaic periods.

The Protohistoric Period

There is no doubt that it was the introduction of the horse that ultimately brought about significant cultural changes in the nonagricultural areas of the

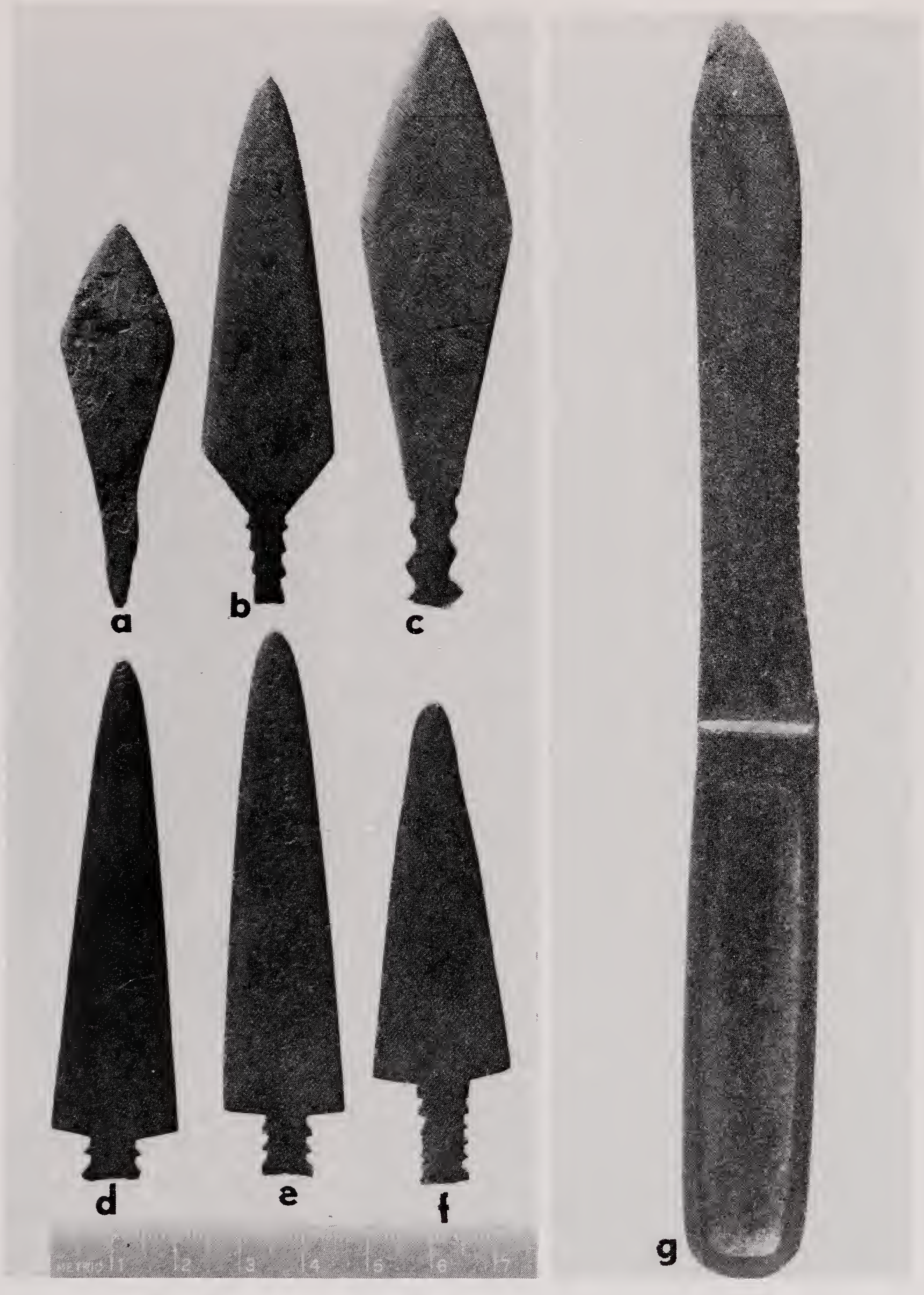


FIGURE 2.18. Metal projectile points (a–f), and knife (g) of the historic period.

Northwestern Plains. The precise date of this occurrence is not well documented in the archeological record. From other sources we learn that the Shoshoneans were getting horses in significant numbers during the first quarter of the eighteenth century; the Crow obtained horses shortly afterward (see Ewers 1955:3–19; Haines 1938:430; Secoy 1953:33–38).

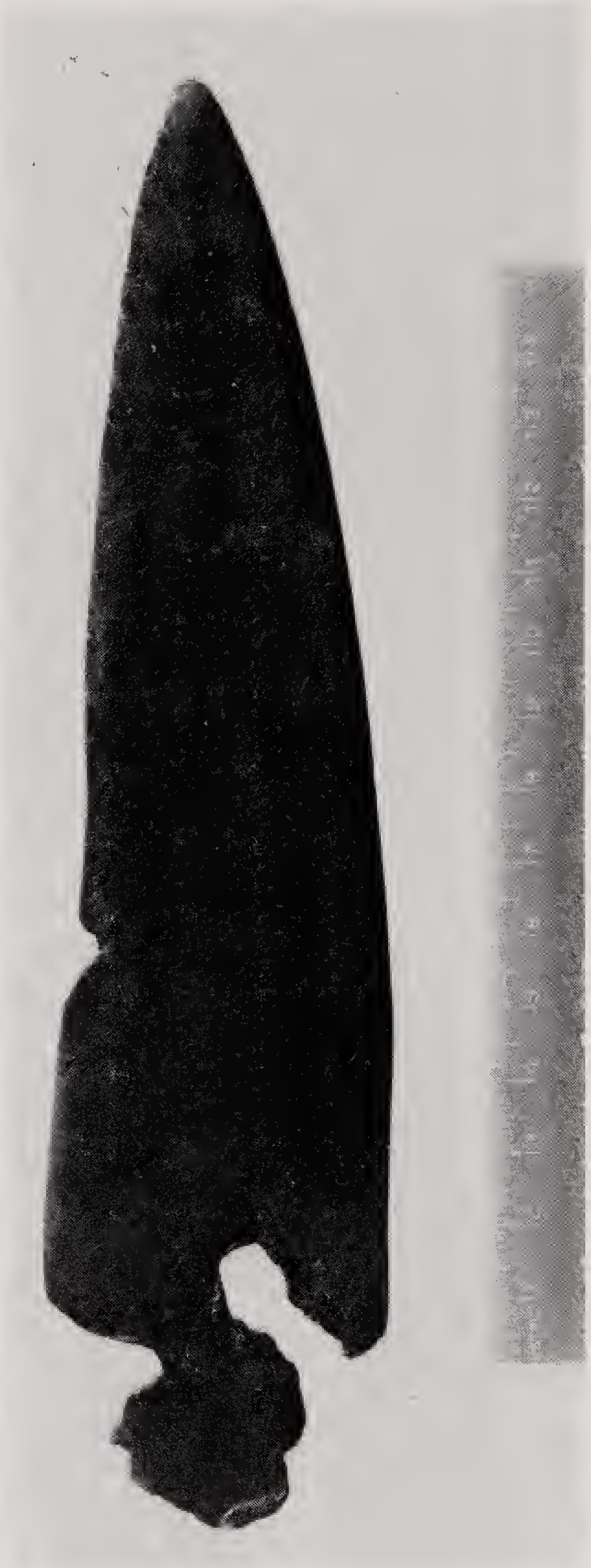


FIGURE 2.19. Hard-hammered metal lance point of the historic period.

Along with the appearance of horses in protohistoric times were small amounts of European goods; these were usually decorative in nature. They were highly prized and usually appear as burial items. European trade beads appeared along with small side-notched, base-notched projectile points in the uppermost level at the Medicine Lodge Creek site. Horse bones appeared along with small side-notched and side-notched, base-notched projectile points in a site in the Sunlight Basin in the Absaroka Mountains on the lowest terrace of Dead Indian Creek adjacent to a large Middle Plains Archaic site on a higher terrace (the Dead Indian Creek site mentioned earlier). I recall a multiple burial, found nearly half a century ago in a crevice in the rocks on the southern slopes of the Bighorn Mountains, that contained among other things a bundle of arrows (some with European metal trade points), some hand-hammered iron projectile points (probably Indian made) and a majority of small side-notched, and side-notched, base-notched, chipped stone projectile points of obsidian.

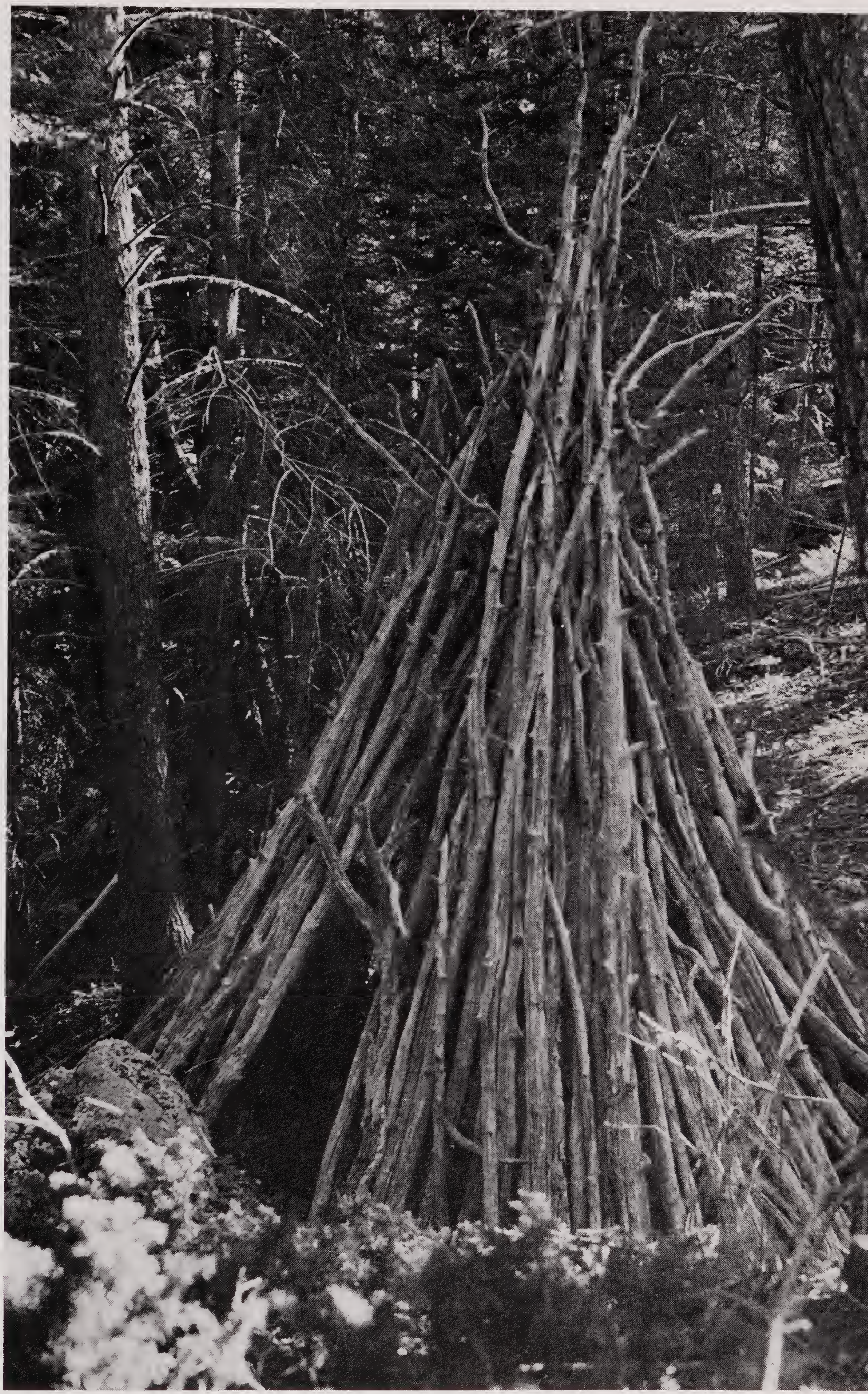


FIGURE 2.20. War lodge in the northern Bighorn Mountains.

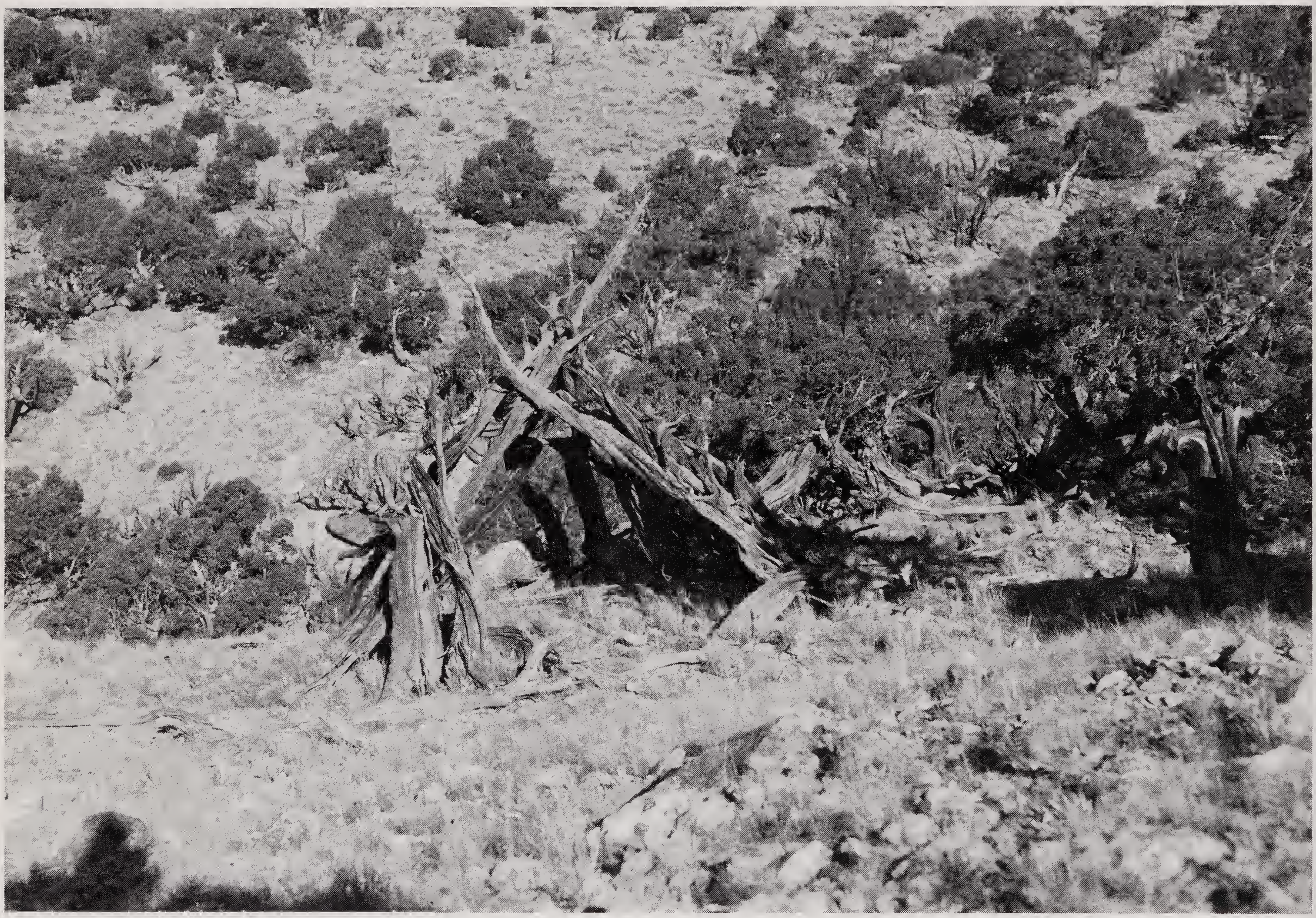


FIGURE 2.21. Juniper tree habitation structure from the southern Bighorn Mountains.

Both European metal trade points and hand-hammered iron points were rather common surface finds a few decades ago but most have now rusted away (Figure 2.18a–f). A hand-hammered brass projectile point and a badly rusted iron awl were recovered at the grass-roots level at the Big Goose Creek site directly above the radiocarbon-dated Crow campsite mentioned earlier (Frison 1967a). There was however no tribally diagnostic material in association with the metal products.

What appears to be a protohistoric Shoshonean campsite is located along the shore of Seminoe Lake, an artificial body of water along the North Platte River northeast of Rawlins, Wyoming. The site to date has produced sherds of both fired and carved steatite vessels; brass fragments that appear to have been hammered with stone tools; a broken blue European trade bead; and both small side-notched and side-notched, base-notched projectile points. The site is submerged most of the time and appears on rare occasions when lake levels are extremely low, making systematic investigation impossible at this time.

Lance points of metal are occasionally found. These were usually larger pieces of metal pounded out with stone tools and smoothed by abrasion on pieces of hard sandstone. An unusually fine example was found several years ago sticking in a large pine tree on Torrey Creek in the Wind River Mountains near Dubois, Wyoming. This particular specimen is hammered and smoothed except for the notched base, which demonstrates laborious hammering—probably with stone tools, judging from the marks left on the metal where it was not later ground smooth (Figure 2.19).

It is interesting to note also the usual treatment given steel knives acquired by the historic Indians in the area. As with their earlier stone tools, they beveled the working edge of the blade on one edge only and instead of maintaining a continuous keen edge, they deliberately placed nicks at close intervals. These were common finds at the turn of the century (Figure 2.18g).

Still in evidence are a number of wooden structures, although these are fast disappearing. They include the game procurement traps and associated corral structures described in Chapter 6 along with the horizontally laid log habitation structures (Figure 6.15). Also remaining are a few vertical-pole war lodges (Figure 2.20) and less sophisticated habitation structures of juniper logs and trees (Figure 2.21), but these also will not survive much longer. Other living structures were built in caves and overhangs, and some of these remain. Most consist of a basic foundation structure of 3 or 4 poles interlocked together at the top and large numbers of poles leaned upright against the walls.

The study of European trade goods is beyond the scope of this book. My intent here is to make note of the earliest known appearances of this kind of material. Unfortunately we know little of the period and the exact movements of the various Indian tribal groups concerned.

TOOL ASSEMBLAGES AS CHRONOLOGICAL INDICATORS

As chronological indicators tool assemblages are not as reliable as projectile points. Some Paleo-Indian tools are quite distinctive but others, such as butchering tools, are not; similar types occur over long periods of time. The sharp gravers and borers of the Folsom Complex are distinctive but these continue with about equal frequency into later Paleo-Indian assemblages. The Cody knife was once regarded as a diagnostic of the Cody Complex but one was recovered in an earlier Alberta Complex bison kill (Agenbroad 1974b). Scottsbluff, Hell Gap, and Fredrick knives have been described (Irwin-Williams *et al.* 1973) but their value as chronological indicators has not yet been proven. The problem is that in bison kill sites many of the same kinds of butchering tools were used from Folsom times until the historic period. These tools were usually made from large percussion flakes that were sharpened with a lateral retouch along one edge. A large sample of Hell Gap projectile points was recovered from the Casper site but the only knife type present was the simple butchering tool just described. The same is true at the Agate Basin site, where the butchering area was characterized by the presence of a number of large percussion flake tools. The same tool type follows through even into sites of the protohistoric period. It is easy to see why this is so, since it was the most functional tool for butchering large animals such as bison. At the Piney Creek site (Frison 1967b), a Crow Indian buffalo jump, large numbers of flake butchering tools appeared that are difficult to distinguish from butchering tools in Paleo-Indian sites.

Spurred end-scrapers are another possible Paleo-Indian diagnostic but again are not absolutely reliable. Of a large sample of end scrapers from the Hanson site (see Figures 4.6–4.9), some do not have a true spur. They occur in other Paleo-Indian contexts but the true spurred end-scraper seems to largely disappear from tool assemblages of the post Paleo-Indian period.

Burination was apparently a common occurrence in certain Paleo-Indian assemblages. Much of this, however, was performed on projectile point fragments. For example, at the Agate Basin site at least five deliberate burin spalls were removed from a midsection of a projectile point (see Chapter 5, Figure 5.7f). There is some question as to whether the Indians were seeking the burin spalls for some undetermined purpose or they were continually resharpening the piece from which the spalls were being removed, since there was no microscopic evidence of wear on the edge formed by the last burin spall. None of the spalls were recovered at the site. Cody Complex projectile point fragments often demonstrate unmistakable evidence of burination. Two obvious specimens are midsections of typical Cody projectile points with true burin spalls; in one specimen the spalls are on two opposite corners and on the other the spalls are on adjacent corners. These were recovered from a Cody Complex site in the same general area as the Finley site. A Clovis projectile point base recovered as a surface find in the Bighorn Mountains bears several deliberate burin spalls. Projectile points of the Pryor Stemmed type often demonstrate burin spalls driven from transverse breaks. These appear especially deliberate, since in more than one instance a second transverse break was made below the first and burin spalls were driven from the last break; the ends of burin spalls that originated from the former transverse break are visible. What could be a true burin tool was recovered at the Casper site (Frison 1974b:96) but the presence of only a single specimen could indicate that it was not a stylized tool-manufacturing process. To date, the burination process is of limited value as a useful chronological indicator for the Northwestern Plains. The investigator is cautioned also that what appears as deliberate burination often occurs on projectile points when thrust into large animals. Channel flakes resulting from Folsom projectile point manufacture were occasionally made into tools and these are obviously a good diagnostic indicator of Folsom.

In summary, Paleo-Indian tools may have good diagnostic value, especially if they are tools made on projectile points. Most other tools known are not time-specific enough to have value as chronological indicators, except within wider limits in the Paleo-Indian period.

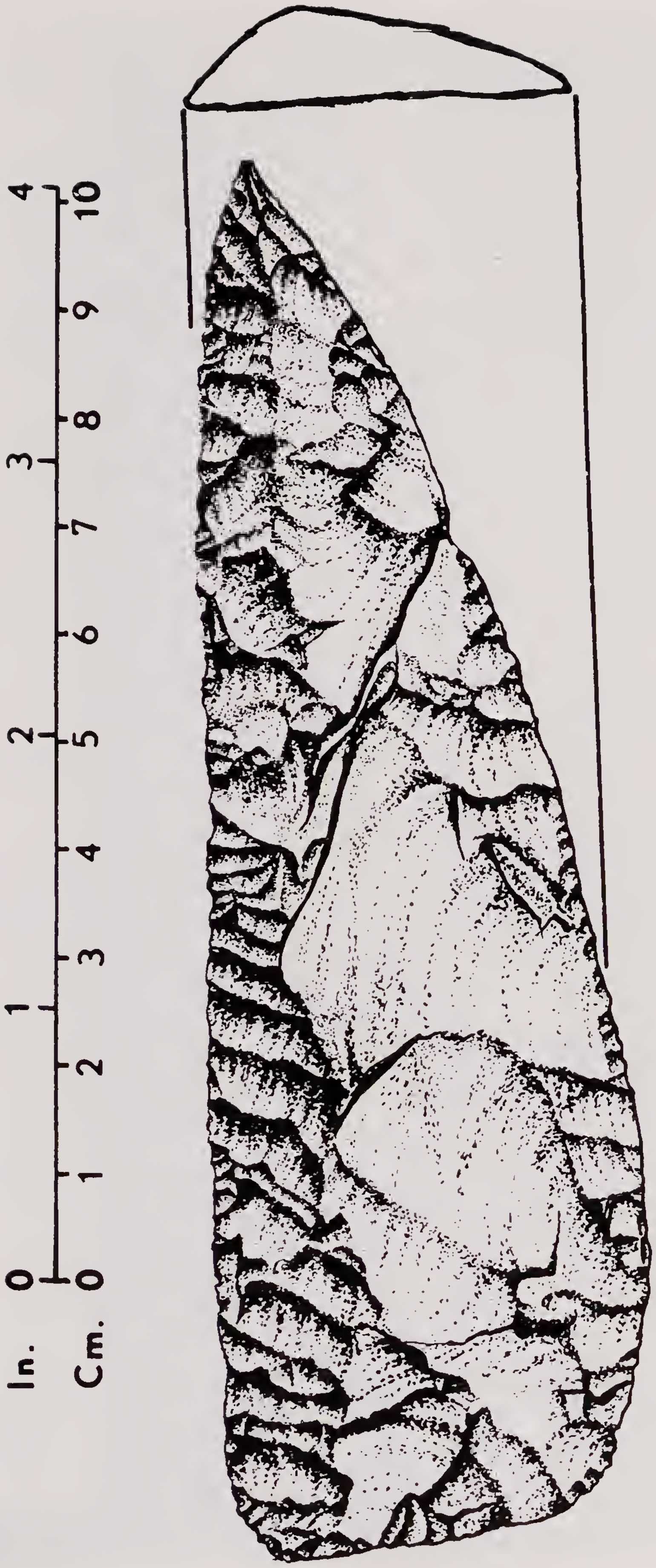


FIGURE 2.22. Knife diagnostic of the Late Plains Archaic period.

Tools of the Early Plains Archaic period are not yet well enough known to determine whether any demonstrate value as chronological indicators. One tool type of the Late Plains Archaic period is somewhat diagnostic. It is a biface knife with a rounded base and sharp point. As it was used, it was sharpened by means of a steep bevel on one side along one blade edge. As a result one face remained nearly flat because all resharpening was done from one side. It also became progressively more asymmetrical through attrition as it was used and resharpened (Figure 2.22). After a tool of this nature was sharpened beyond a certain point, it was no longer functional. Considerable time has been spent

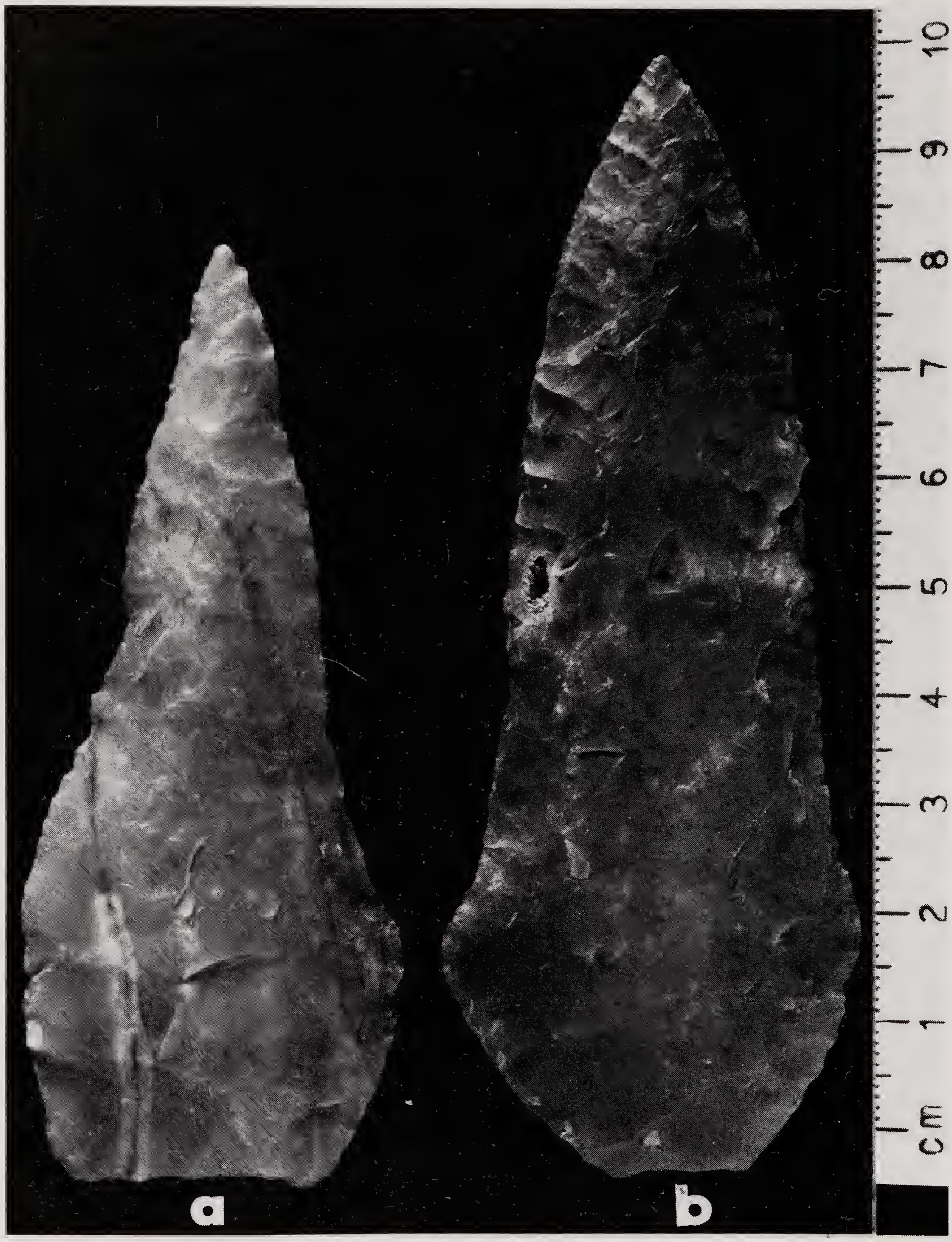


FIGURE 2.23. Diagnostic tools from Late Prehistoric period Shoshonean sites. Both are from the Shirley Basin site (Zeimens 1975).

postulating a use for artifacts of this particular type after they were no longer of any value as knives. With regard to function, it is the same tool as the large percussion flake butchering tools that were sharpened by a lateral retouch on the back of the flake. It is noted also that a left-handed person beveled the edge opposite to that of a right-handed person. Occasionally notches were added on the corner opposite the working edge. We do not know whether the notches were there so a handle could be added or merely to tie a thong around for carrying purposes. To date, at least, this tool seems to be a reliable diagnostic of the Late Plains Archaic period.

A possible diagnostic of late Shoshonean sites is a tool that was made on a leaf-shaped biface. Both blade edges were resharpened bilaterally so that the tool remained symmetrical in outline form and retained a lenticular transverse cross-section. This tool type was resharpened until the blade became so long and thin that it broke and it was then discarded (Figure 2.23). Apparently it was utilized as a knife and it appears to be a fairly reliable horizon marker for late Shoshonean occupations (see Frison 1971b:269). It appears also in sites that demonstrate mixing of Crow and Shoshonean pottery.

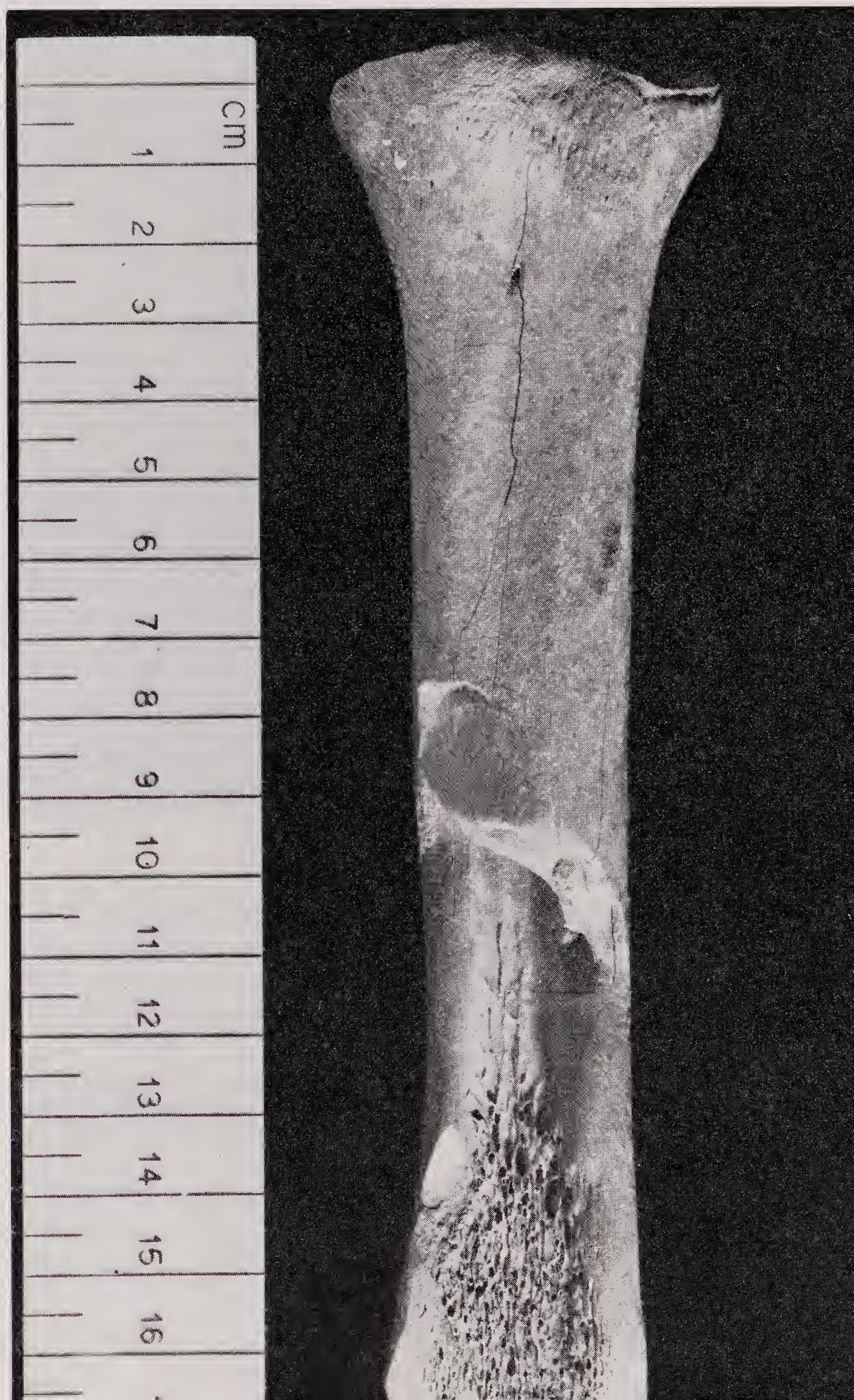


FIGURE 2.24. Toothed metatarsal flesher diagnostic of the Late Prehistoric period.

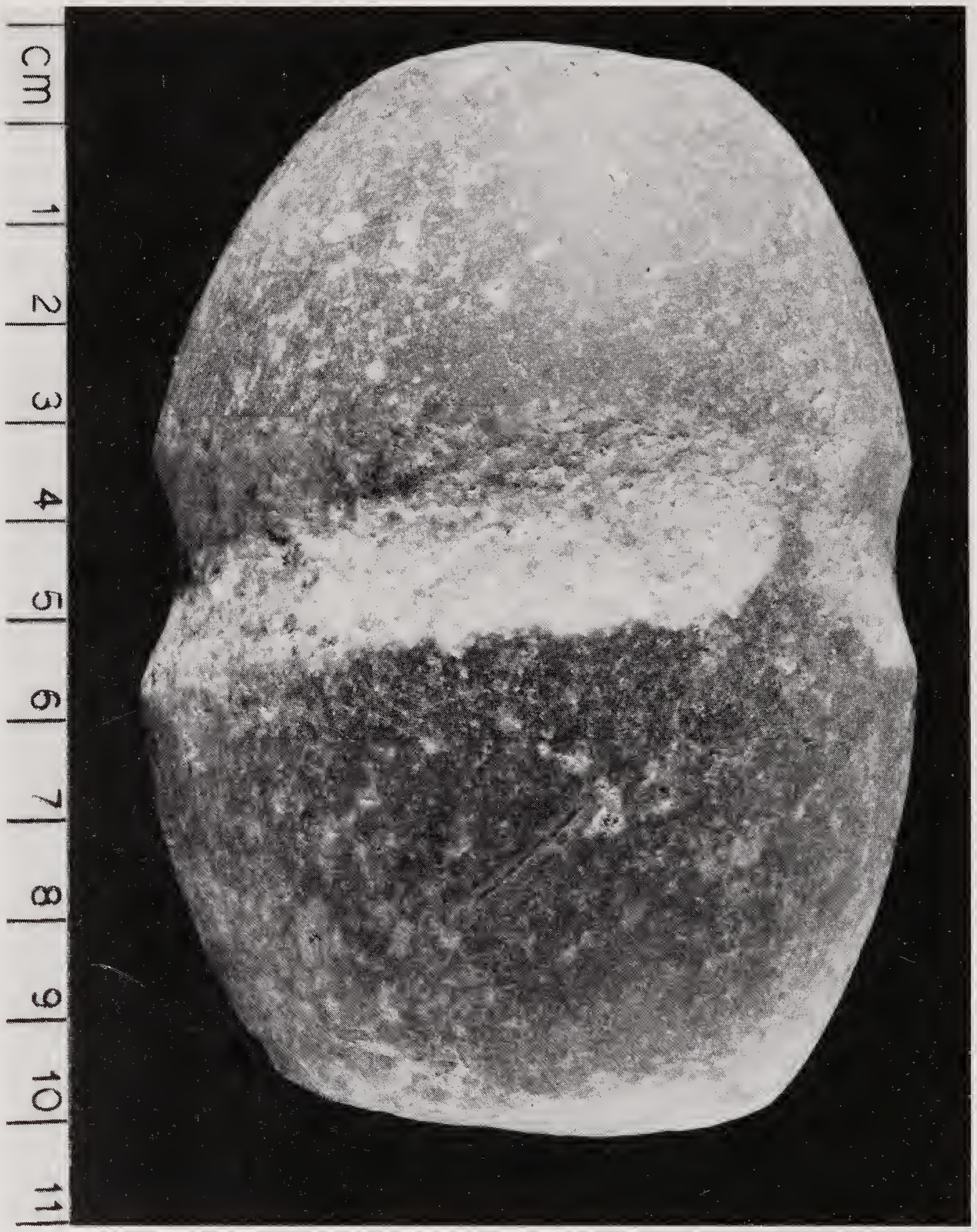


FIGURE 2.25. Grooved maul diagnostic of the Late Prehistoric period.

Other chipped stone tool types of the post–Paleo-Indian period have little diagnostic value. As with Paleo-Indian assemblages, some tools are made from projectile points and these have essentially the same diagnostic value as the projectile points themselves, provided enough remains for reliable type identification.

The serrated metatarsal scraper (Figure 2.24) and grooved maul (Figure 2.25) are widespread diagnostic items of the Late Prehistoric period on the Northwestern Plains. The former was usually made of a bison metatarsal but occasionally the metatarsal of an elk was used; the mauls were usually made of river cobbles. Grooves may be continuous or discontinuous as shown in Figure 2.25.

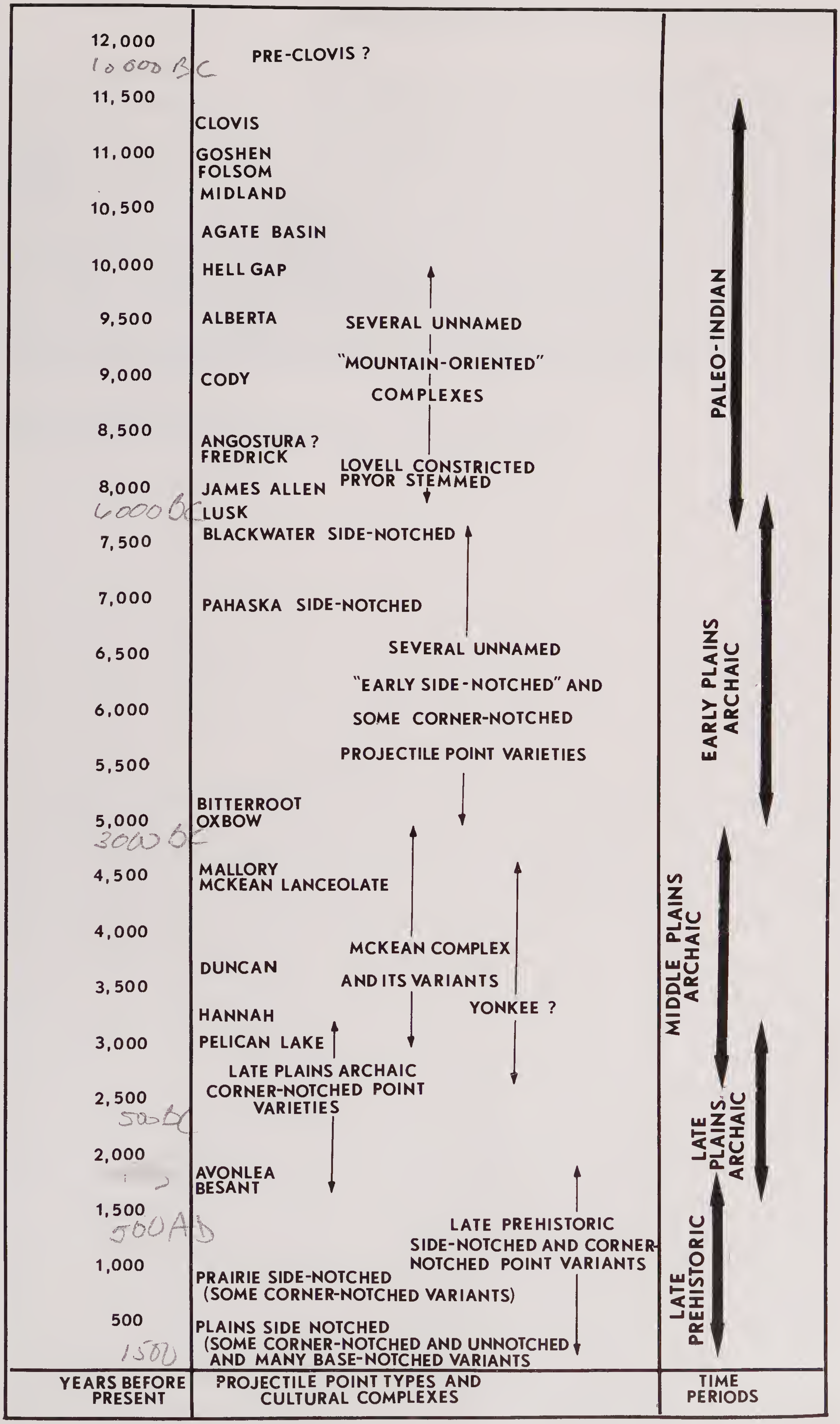


FIGURE 2.26. Northwestern Plains cultural chronology based on radiocarbon dates and projectile point types.

In conclusion, the present cultural chronology of the Northwestern Plains is based mainly on stratigraphy and projectile point, tool, and ceramic typology, buttressed strongly by an increasing number of radiocarbon dates. Obsidian dating promises to be of greater benefit as the method is further refined (see, for example, Davis 1972). Present major problems in chronology for the area center around the foothill-and-mountain-oriented Paleo-Indian groups and the cultures of the Early Plains Archaic period. Even though the chronological picture is becoming better known, there are still innumerable questions as to what cultural groups are represented, where they came from, and what they were doing there. Time relationships are becoming better known (Figure 2.26) but must remain flexible to allow for the accumulation of more exact data.

3

The Clovis Complex and Mammoth Hunting on the Northwestern Plains

Clovis fluted projectile points are occasional surface finds over much of the Northwestern Plains, except for high altitudes above the timberline. In rare cases they have been found up to within a few hundred feet of timberline in the Bighorn Mountains, and they probably have been found in many other places unknown to me. Clovis projectile points were found in deflated deposits at the Carter-Kerr McGee site near Gillette, Wyoming.

Mammoth (*Mammuthus* sp.) remains follow about the same geographic pattern (see Anderson 1974), except in the mountain areas. Firm evidence of associations of mammoth and man has been scarce. The Union Pacific Mammoth site (McGrew 1961) may show human association; bones other than mammoth were recovered and some of these as well as the mammoth bones demonstrate evidence of possible butchering by humans. However, not all the bones were available to me for observation and analysis. We are also hampered because the complete results of the investigation have not been published.

Mammoth remains and Clovis points at about 11,000 years ago were reported from loess deposits near the Hell Gap site in Platte County, Wyoming, but no other details are known (Greene 1967). An articulated mammoth skeleton in the Rawhide Buttes area of Niobrara County, Wyoming, was reported to have charred vertebrae but no artifacts were recovered. A radiocarbon date of 10,550 ± 350 years ago (A–366) (Damon *et al.* 1964) was recovered on overlying deposits. Of 16 other finds of mammoth remains in Wyoming, only the Colby site mammoths (to be discussed in detail in this chapter) can be definitely claimed as Clovis-related. The

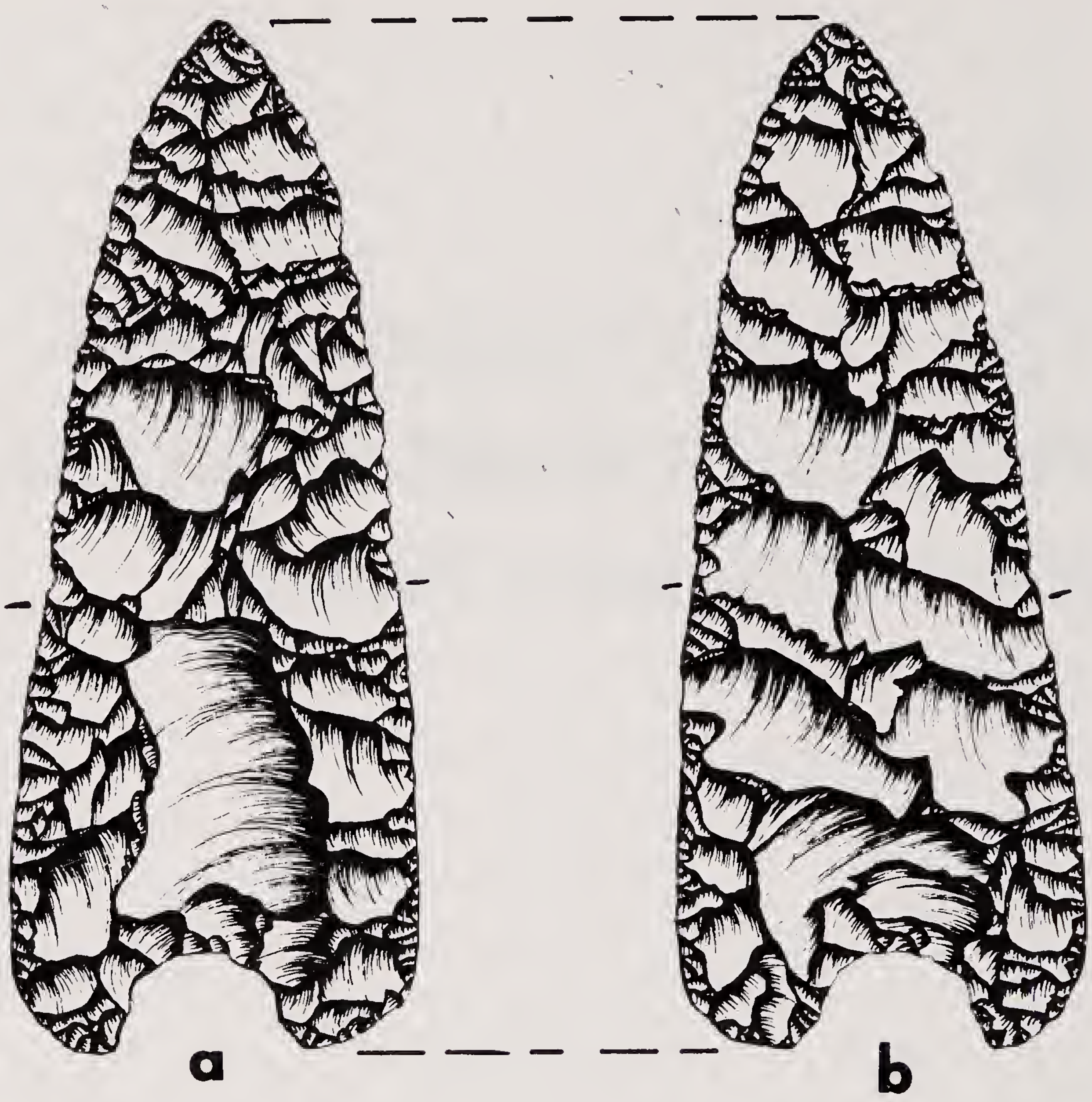


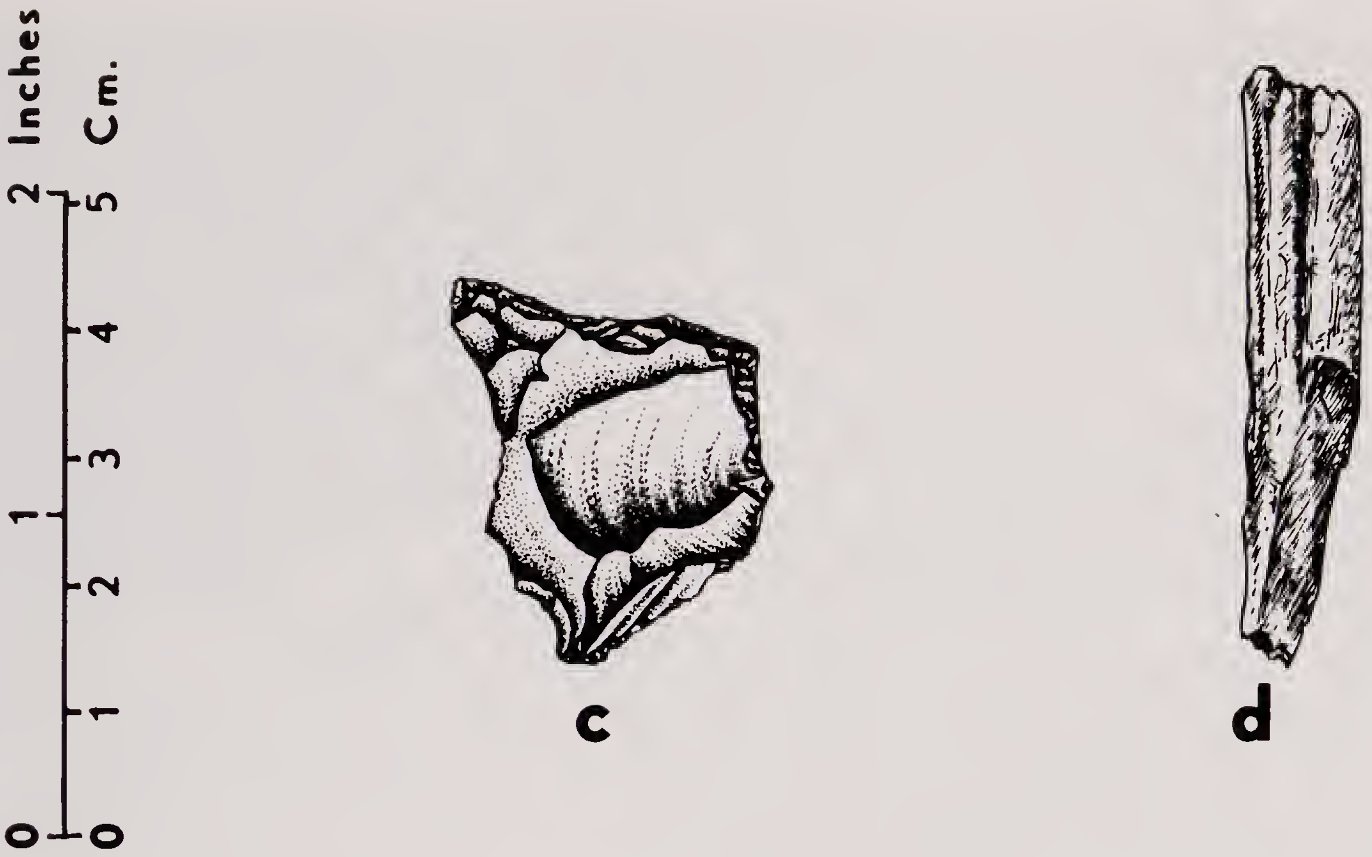
FIGURE 3.1. Projectile point (a, b), stone tool (c), and possible bone foreshaft fragment (d) from the Colby site.

Lindsay Mammoth site in east-central Montana is provocative, but it lacks absolute proof of human association (Davis 1971). Although extreme care was taken in this excavation, no stone tools, bone tools, or projectile points were recovered. However, the presence of alien stones and the distribution of bones strongly suggest some human agency might have been involved. Dates for the Union Pacific Mammoth site and the Lindsay Mammoth site (Table 2.1) place them at about 11,000–11,500 B.P. These dates bracket the mammoth sites in North America associated with artifacts of the Clovis Complex (Haynes 1970).

At least six immature and one mature mammoth plus unquestionable evidence of human association have been found in the Colby site in the Bighorn Basin of north-central Wyoming. The site is only partly excavated. The size and complexity of the site, plus the fact that much of the site is at present under water, indicate that excavation will probably not be completed for at least several years. The investigations to date have uncovered some significant evidence concerning man and mammoth relationships, and I shall discuss this next.

THE COLBY SITE

The Colby site was first brought to light in the 1960s when Donald Colby of Worland, Wyoming, uncovered a fluted projectile point (Figure 3.1a, b) while



operating heavy equipment during the construction of a reservoir. Shortly afterward, mammoth tooth plate fragments appeared in the immediate area of the projectile point discovery. At that time, it was believed that the tooth fragments were in a thin layer of soil on top of a terrace along an arroyo and that there was little or no possibility of deeper soil deposits. Consequently, the area was not investigated further until 1973.

In the fall of 1973, a badly decomposed mammoth tooth was discovered eroding from the surface. Closer examination nearby also revealed part of a mammoth radius eroded off at ground level. Test excavations revealed alluvial deposits with considerable amounts of mammoth bone. The earlier observers were correct in that the mammoth material was present on a terrace, but they could not know without excavating that beneath the terrace was an old alluvium-filled arroyo that contained remains of an unknown number of mammoths and smaller amounts of other faunal material.

The geology of the Colby site should be mentioned. The site location is about 5 miles east of the Bighorn River. The area is in the Eocene Willwood Formation, which is a variegated shale that decomposes rapidly. Color varies from a light tan through dull green to a light purple. Bentonite occurs throughout the formation and the site area is well known for its "gumbo" conditions in wet weather. There is little topographic relief from the Bighorn River to the site area but east of the site the land is highly dissected as a result of erosion along a steep scarp that parallels the Bighorn River for several miles. The site area is drained by an intermittent stream (aptly named Slick Creek because of the gumbo conditions), which empties into the Bighorn River. The Colby site is in a small, dry tributary of Slick Creek (Figure 3.2). At least 300 feet of an old arroyo contains mammoth bones. Several hundred more feet of the same arroyo is presently under water from an artificial reservoir. It is feared that some of the

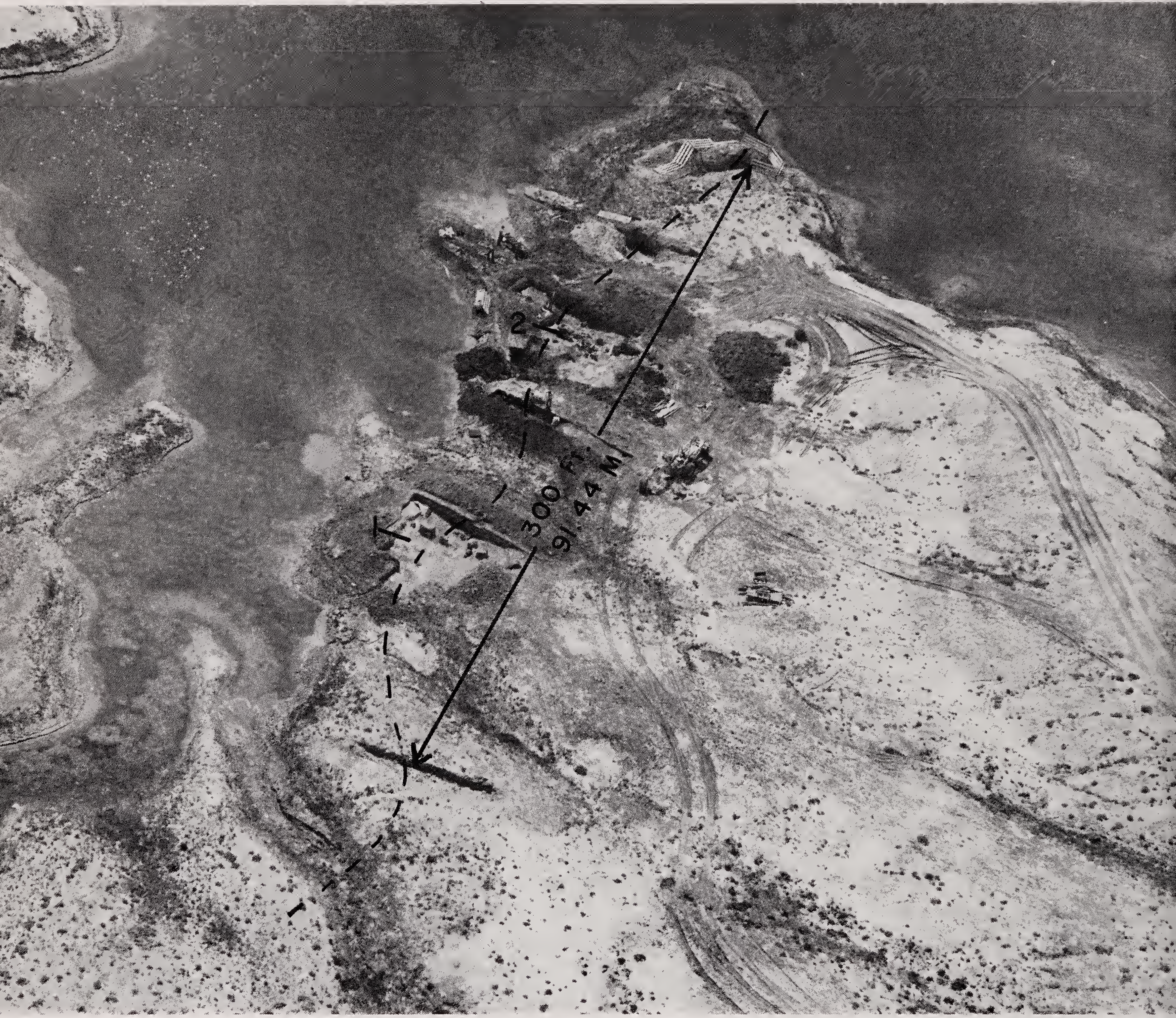


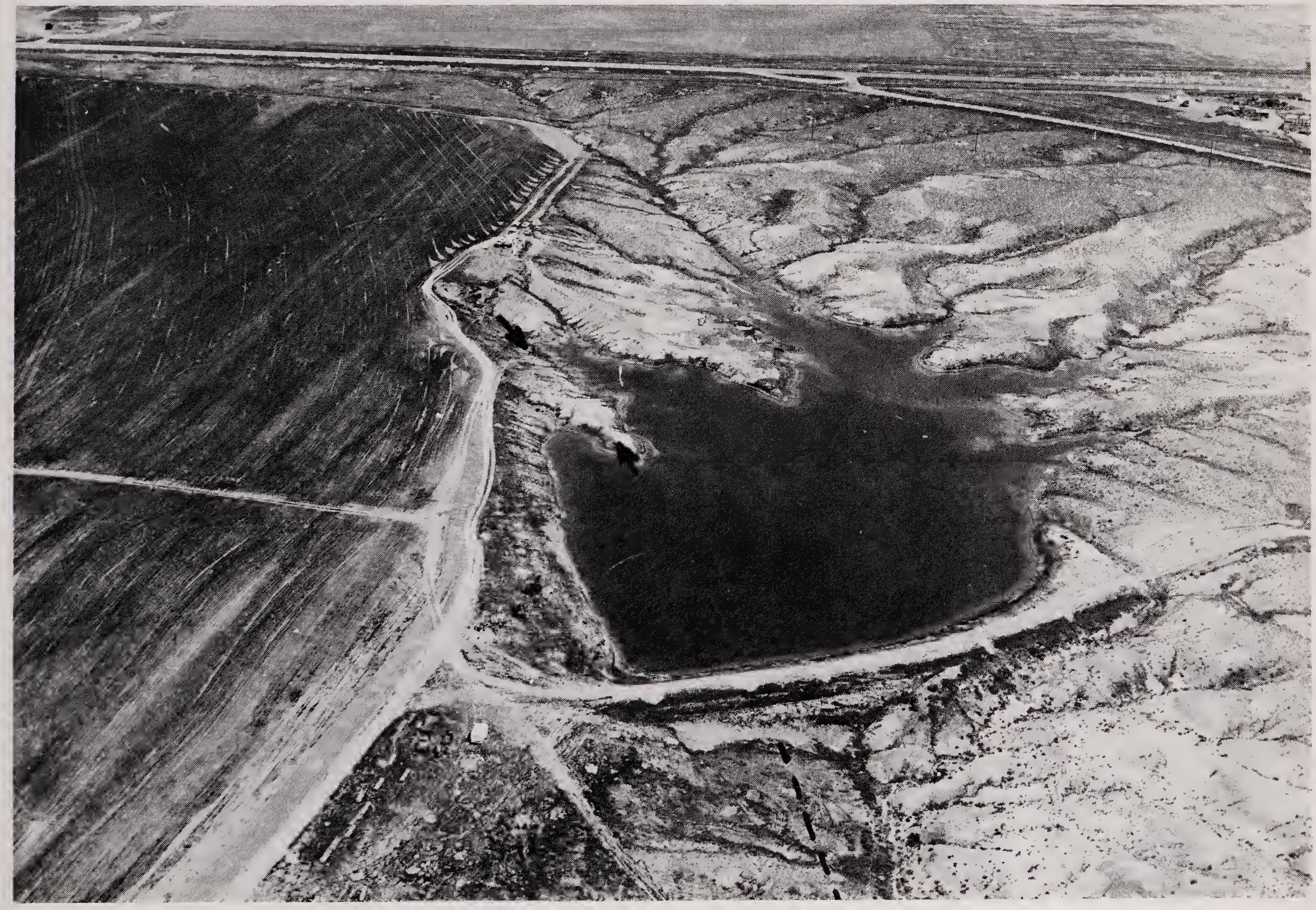
FIGURE 3.2. Aerial view of the Colby site excavations.

site area under water was destroyed during reservoir construction, because most of the material for the dam was taken from the bottom in front of the dam rather than from the nearby hills above it. For several hundred feet below the present dam the alluvial deposits filling the old arroyo are quite deep, and in one spot, where the excavators have reached the old arroyo bottom, mammoth bone fragments were recovered. A short distance further on, the old and new arroyos join. The entire site is situated toward the head of a small dendritic drainage feature that formed as a result of headward erosion into a Pleistocene terrace, even though the source of runoff water is only a short distance (Figure 3.3).

Subsequent to the site activities, the old arroyo containing the mammoth bones filled with alluvium. The present arroyo is several feet to the east and parallel to the old one. The site area has undergone considerable downcutting since the site activities occurred and the bedrock of the Eocene Willwood Formation forms the present surface everywhere except for the alluvium exposed in the old arroyo (see also Appendix 2 for a further discussion of Colby site geology).

It is believed that most of the actual site activity took place out of what presently remains of the bottom of the old arroyo—although we will probably never know how much. There also is little doubt that downcutting removed much of the site. In addition to this downcutting action of the main arroyo,

FIGURE 3.3. Aerial view of the Colby site area. Excavations are between the two arrows.



several smaller arroyos entering the present main arroyo from the west have trenched directly across the old arroyo to reach the present one, removing considerable amounts of alluvium from the old arroyo in the process. Such erosion has left only a small part of the site as it must have existed originally. What is left, however, can very likely be of considerable importance when the final interpretations on New World mammoth procurement are written.

THE BIGHORN BASIN OF WYOMING

The Bighorn Basin is considered an enclave of the Northwestern Plains although it is ecologically different from the true Plains. Lying within the rain shadow of the Absaroka Mountains, the interior Bighorn Basin is relatively dry and vegetation is sparse. Present annual precipitation is about 7.75 inches/year. Most of the rain falls in April, May, and June, and there is another small peak in September and October. The entire basin is drained by the Bighorn River—which, before entering the basin from the south, is known as the Wind River. The lower elevations of the basin comprise an oval area of about 100 × 50 miles. Four mountain ranges, the Absaroka Mountains and the Owl Creek Mountains to the west, the Bighorn Mountains to the east and south, and the Pryor Mountains to the north, surround the basin. From east to west it is about 125 miles between mountain divides. North to south, from the highest part of the Pryor Mountains to the divide of the Owl Creek Mountains, is just over 100 miles.

The terraces of the Bighorn River valley are about 4 miles wide for a distance of several miles both north and south of the Colby site area. All this area is irrigated today and is quite fertile, except for the higher terraces where soils are shallow. Before cultivation the site area was a sagebrush and grassland community. Major grasses include western wheat grass (*Agropyron smithii*), sandberg bluegrass (*Poa secunda*), blue grama (*Bouteloua gracilis*), and Indian ricegrass (*Oryzopis hymenoides*). Gumbo soils are quite common and are characterized by saltbush (*Atriplex* sp.). Big sagebrush (*Artemisia tridentata*) grows here, especially in deeper alluvial soils along arroyo bottoms, and rabbit brush (*Chrysothamnus nauseosus*) is widely dispersed but in thin concentrations. Greasewood (*Sarcobatus vermiculatus*) is found in the tight, gumbo soils, and in the small springs or "seeps" that appear from time to time as groundwater conditions allow. Plains prickly pear (*Opuntia polyacantha*) grows well in the sandier areas, very much in evidence where sandstone has been exposed.

The highest recorded temperature in Wyoming (114° F) was recorded in the Bighorn Basin in 1900. The highest maximum temperature recorded for the site area is 104° F during July, and the lowest temperature observed is −50 F recorded in January. Winter chinook or warm winds are rare in the basin but are common just over the Bighorn Mountains to the east.

To summarize, the Bighorn Basin is an arid intermontane basin with hot summers and cold winters. Vegetation consists of sparse, short grasses and scattered shrubs. The Colby mammoth site area lies in the center of the basin on the eastern edge of the Bighorn River valley. Nothing indicates that a natural water source was present at the Colby site and present ecological conditions can most certainly not be considered as supportive of a mammoth population in the Bighorn River valley. Some indications of more favorable past conditions have been realized through studies of opal phytoliths or preserved remains of microscopic opal structures in stems of grasses which strongly indicate a grassland dominated more by the taller panicoid grasses (McDonald 1974). Pollen studies have not proven of value since pollen preservation has apparently been poor.

MAMMOTH REMAINS AT THE COLBY SITE

The first mammoth bone discovered *in situ* at the Colby site included a pair of mandibles, an ulna, and several rib and vertebra fragments, all badly decomposed. One projectile point (Figure 3.4a, b) was recovered *in situ* with this bone material in 1973, along with several tool sharpening and use flakes and a possible impact flake. Several other rib and vertebra fragments and another projectile point (Figure 3.4c) were recovered in 1975 in an extension of the excavations. These deposits were in the old arroyo fill but were above and separate from a bone assemblage below. At this time it appears that the deposits containing some mammoth bone and projectile points were derived from higher up, probably from slumping of deposits on the arroyo bank. If this is so, we can postulate further that a good deal of site activity did occur on the banks of the old arroyo. In fact, this could have been where most of the site activity took place and the piles of bone found in the bottom of the old arroyo could be peripheral to the main focus of site activities.

In addition to the slump deposits, the old arroyo bottom at the Colby site has so far yielded two deliberately stacked piles of mammoth bones just over 100 feet apart (Figure 3.5). The first pile lay about 30 cm directly underneath the discovery materials. Scattered mammoth remains were also present at every location tested in the bottom of the old arroyo; other piles of bones are expected to be found when the remainder of the old arroyo is excavated. The first pile of bones was excavated in the fall of 1973, the second pile in the summer of 1975. The first pile was somewhat dispersed (Figures 3.6 and 3.7). The second (Figure 3.8–3.11) demonstrated much less disturbance. The dispersed pile was closest to the top of the ground and the bone here was rather poorly preserved. The maximum depth of the arroyo fill here was 88 cm.

The bone in the first pile was at the bottom of the old arroyo and somewhat scattered. This is now believed to have resulted from human activity and not arroyo cutting. At least three immature mammoths were represented in the bone pile as is indicated by three left scapulae. No articulated bones were in

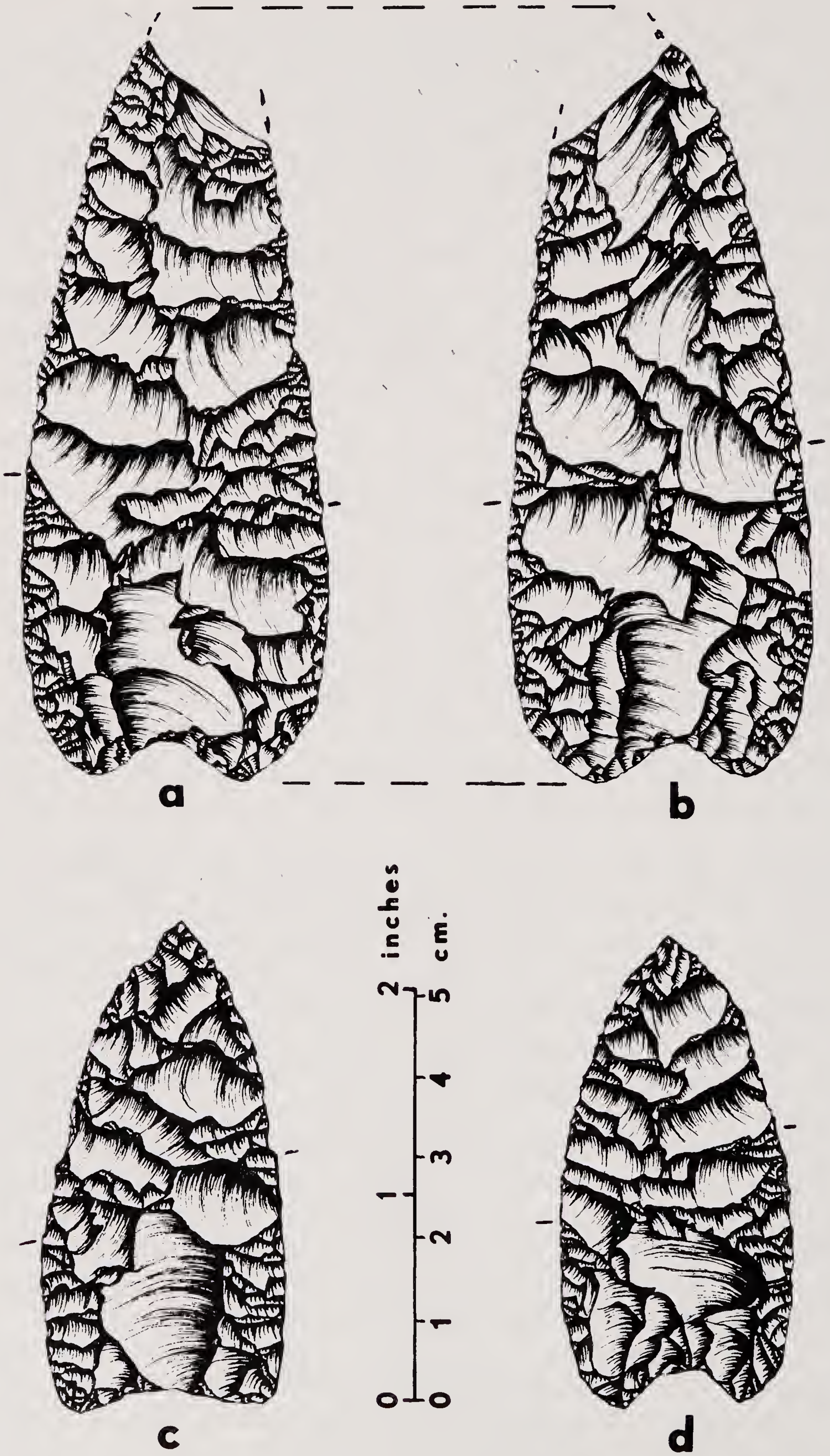


FIGURE 3.4. Projectile points from the Colby site.

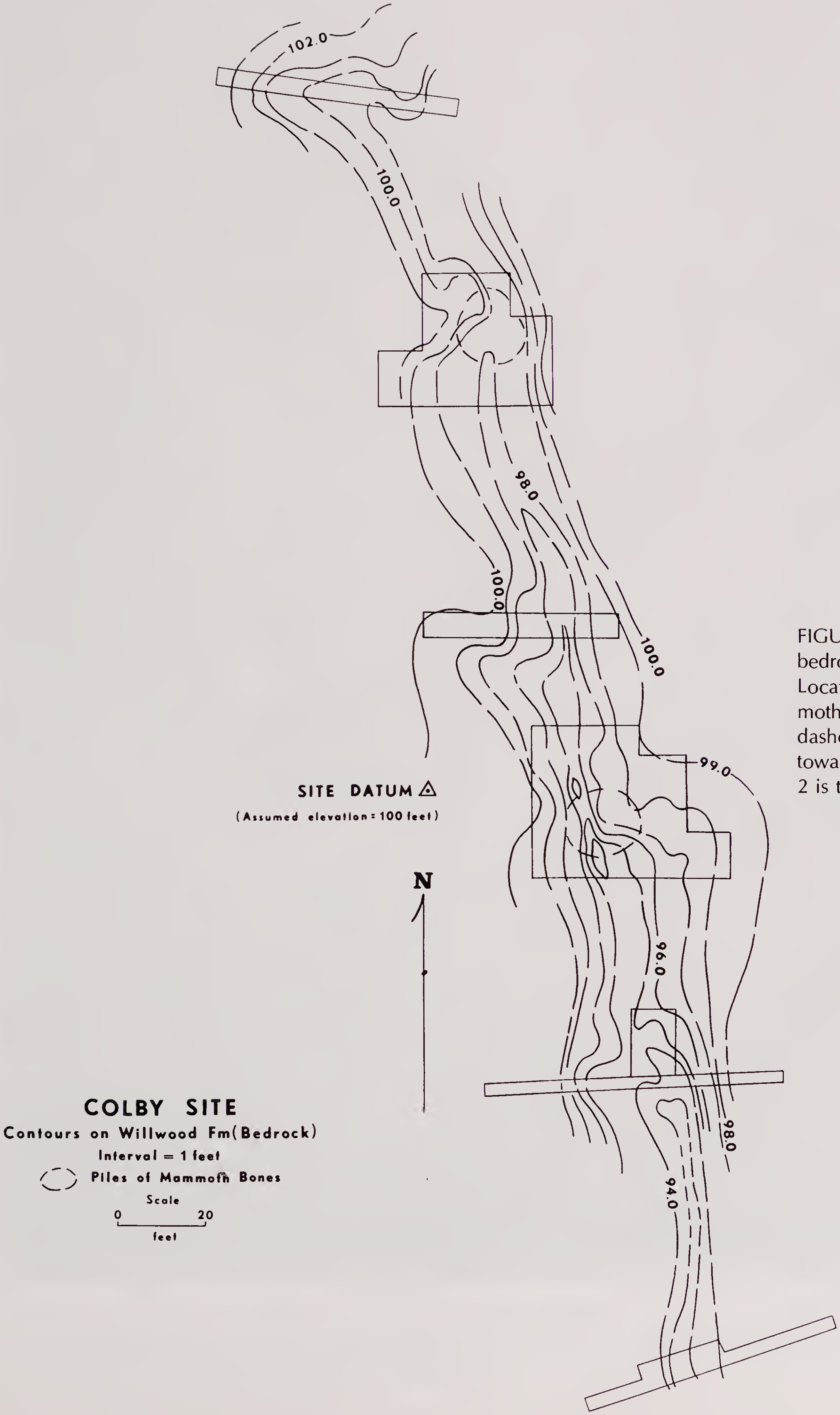


FIGURE 3.5. Contours on bedrock at the Colby site. Locations of stacked mammoth bones are indicated by dashed circles. Bone pile 1 is toward the north; bone pile 2 is toward the south.

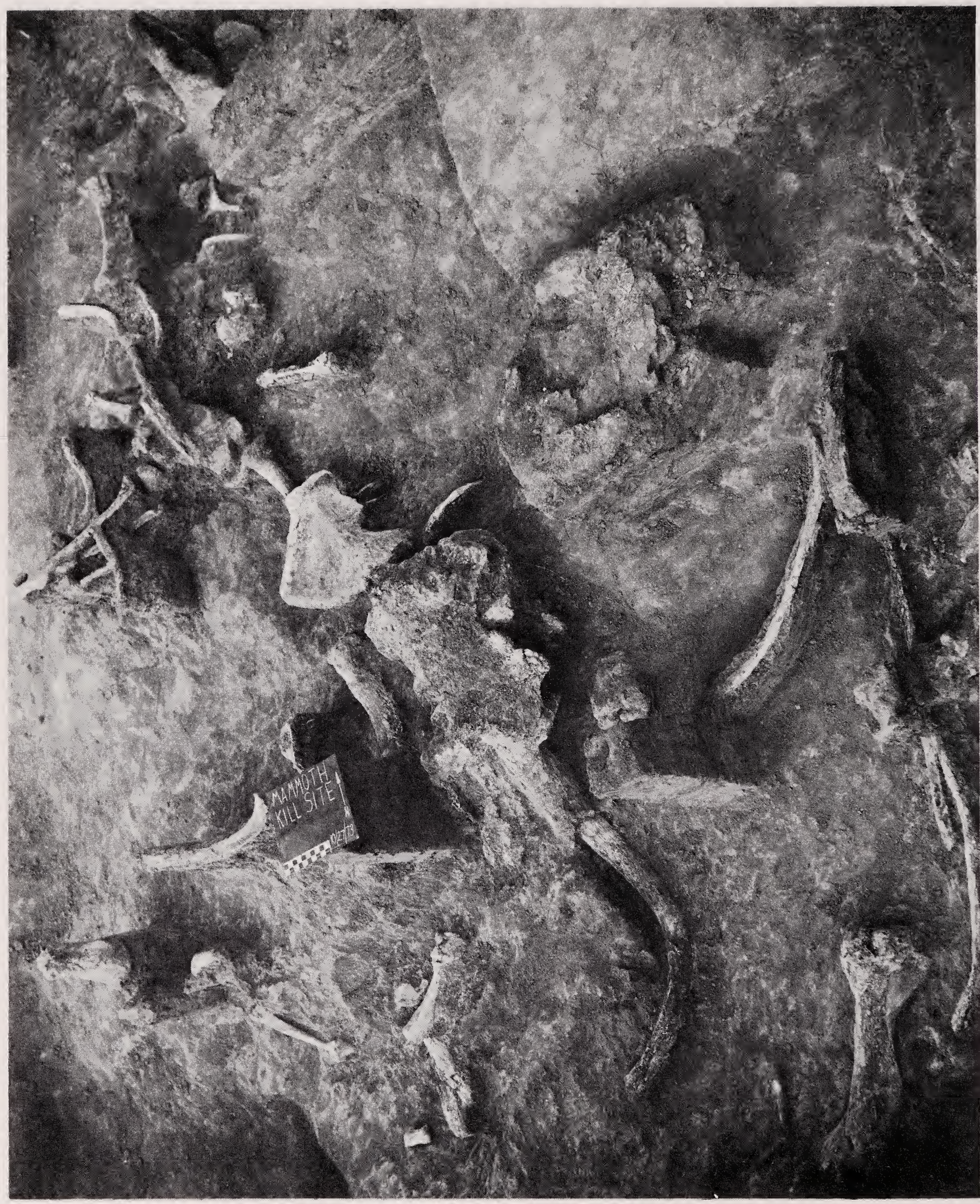


FIGURE 3.6. Bone pile 1 partly excavated at the Colby site. Right tusk of skull is not yet exposed and mandible (see Appendix 2, Figure A2.2) is also unexposed and lies alongside right tusk. Badly deteriorated separate halves of young adult mandible is directly to the right of the skull.

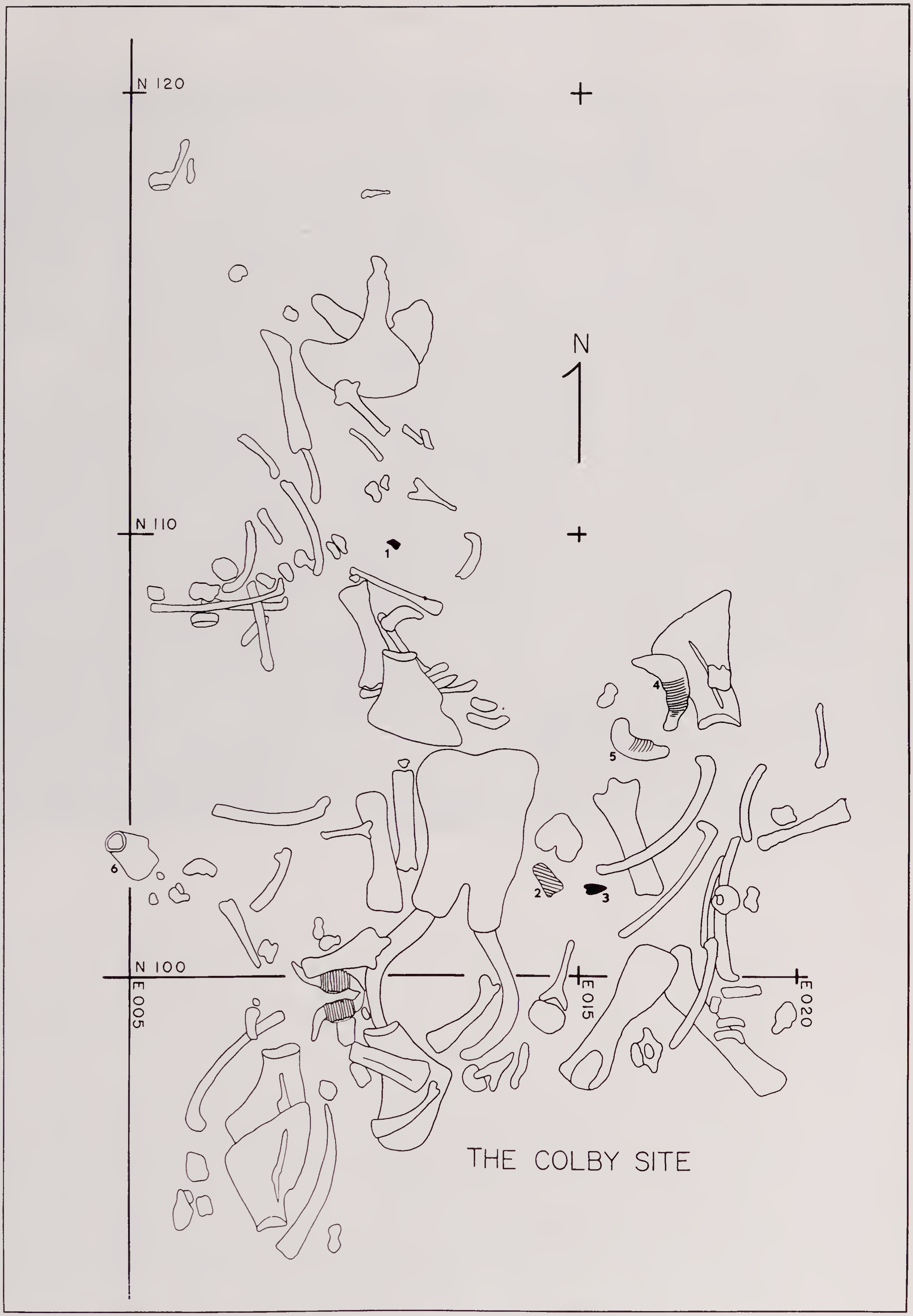


FIGURE 3.7. Bone distribution map of bone pile 1.

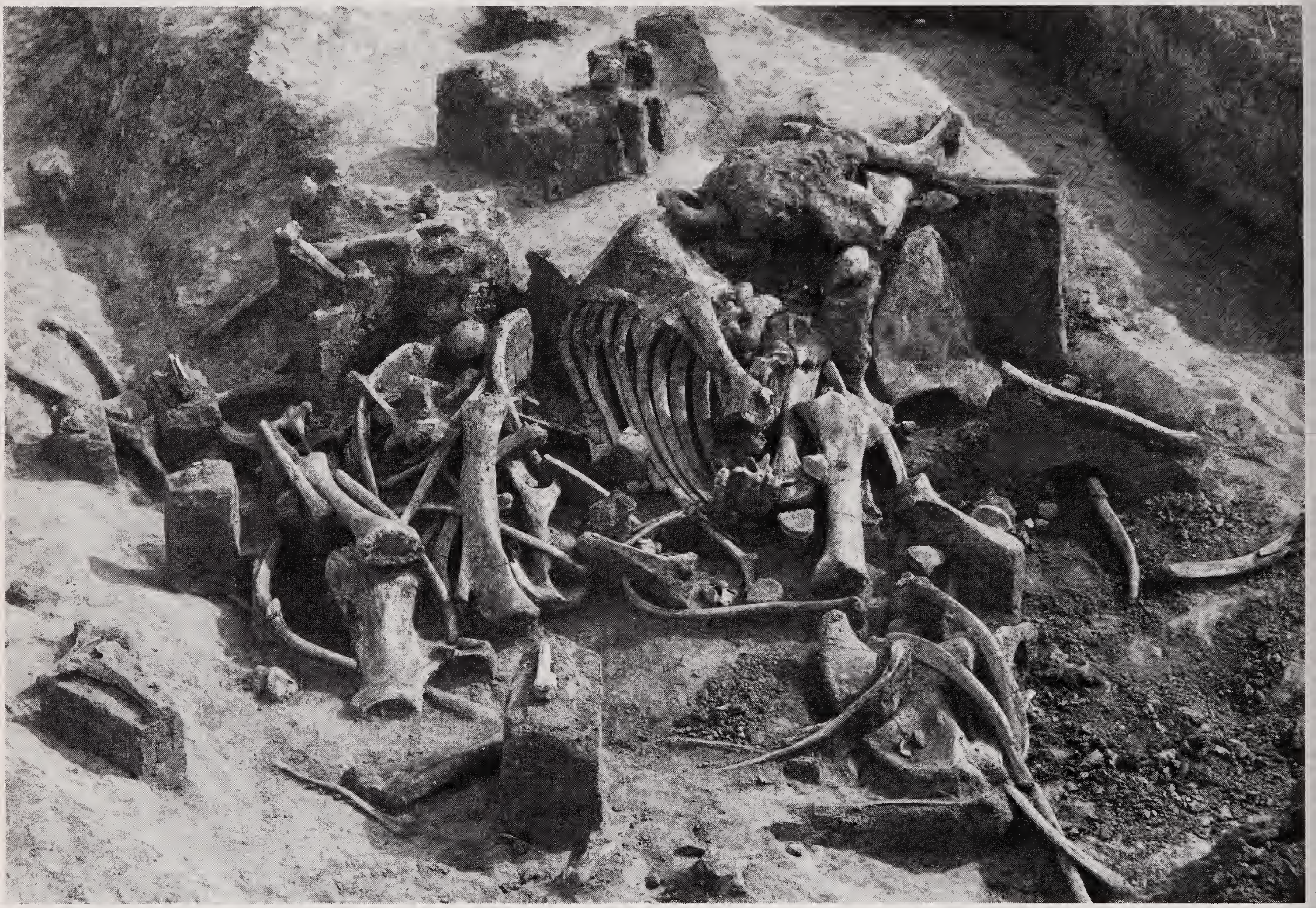


FIGURE 3.8. Bone pile 2 at the Colby site.

the pile except for three thoracic vertebrae that were very nearly articulated. The one skull present had tusks just over 3 feet long. The skull was in the upright position and the top had either eroded away or had been deliberately removed, from the eye sockets to the top of the skull. The mandibles lay alongside the skull and both lower and upper teeth were in fair condition; the tusks were particularly fragile.

A number of questions arose from the excavation of the first pile of mammoth bones. The artificial nature of the bone pile strongly suggested human activity but the paucity of artifact material could not be accepted as commensurate with the activity that was thought to have occurred in butchering three mammoths—even though they were all immature and relatively small animals. The artifact material in direct association with the bones in the pile amounted to a small flake tool (Figure 3.1c), one hammerstone (Figure 3.12a), a small number of what are probably tool sharpening and tool use flakes, and two small flakes that strongly suggest projectile point impact flakes. It is the kind of assemblage that might be expected in dismembering large animals, but the

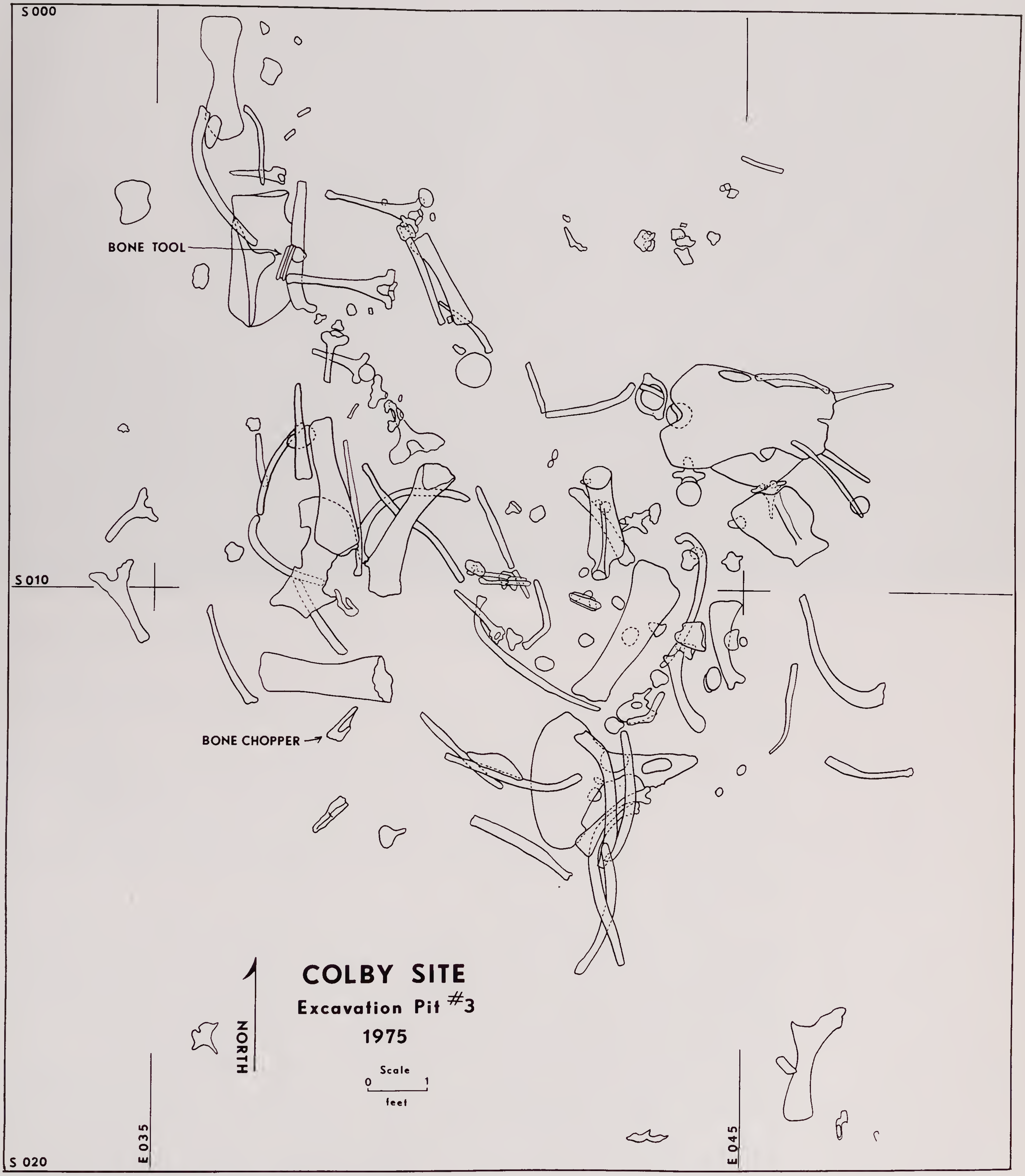


FIGURE 3.9. Bone distribution map of part of bone pile 2 at the Colby site.

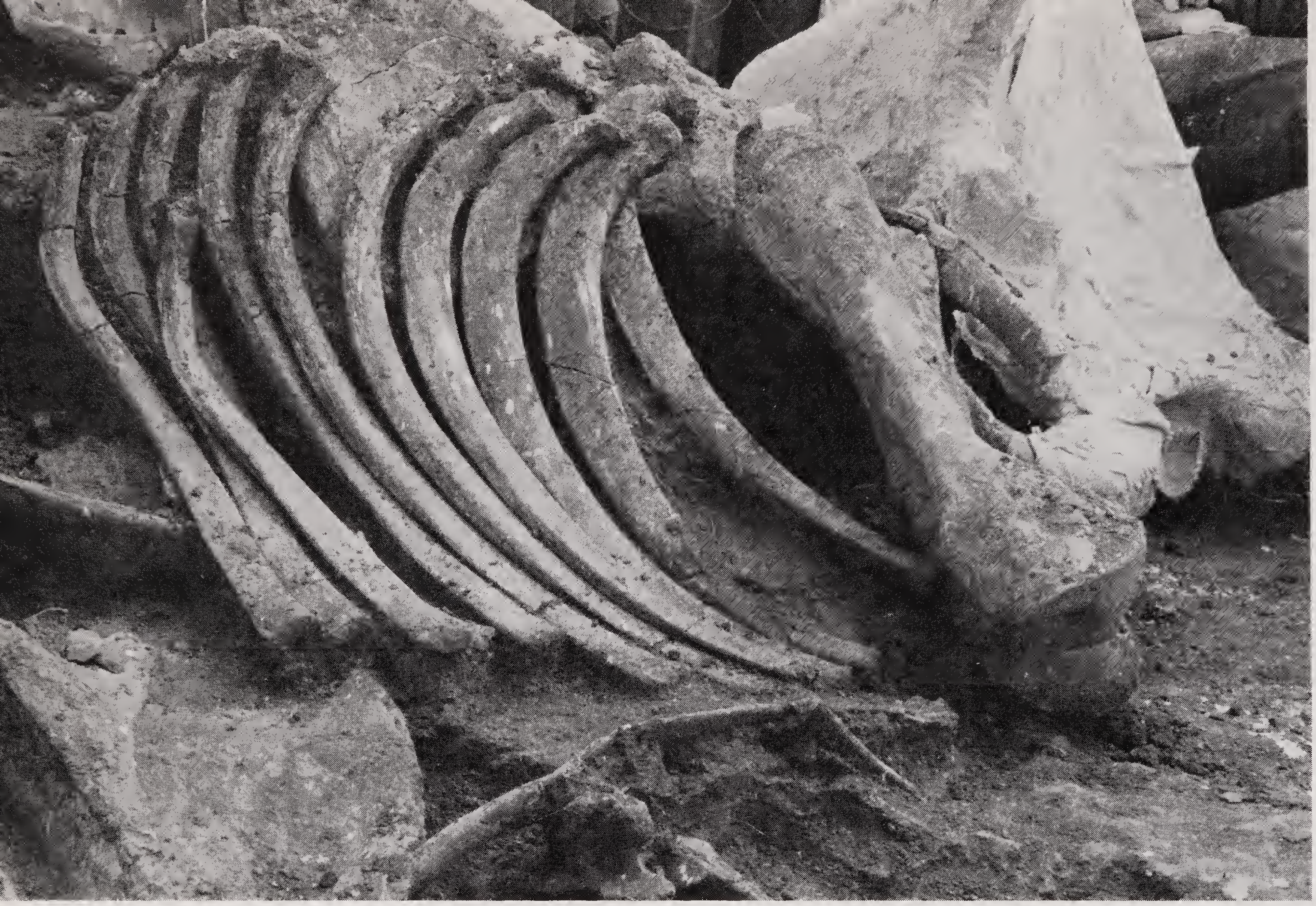


FIGURE 3.10. Articulated unit consisting or rib cage and scapula–humerus in bone pile 2 at the Colby site.

number of tools seems to be too small to be commensurate with the amount of activity that should have occurred.

There appears to be no doubt that the pile of bones is a discrete unit, entirely separate from the discovery bones directly above it. The geologic unit containing the latter is entirely different in character from the deposits surrounding the former. It is believed that the bottom-level bones were originally stacked there whereas those directly above were derived by slope slumping from above.

Excavations at the site were extended slightly in 1975. The area immediately south of the first bone pile was uncovered and the findings further emphasize that the first bone pile was a discrete unit. An increasing concentration of long bones after several feet of relatively sterile arroyo bottom indicates that another pile of bones might be located not far from the first.

A major excavation was planned for the summer of 1976. The main effort was to excavate a suspected concentration of mammoth bone in the old arroyo about 100 feet south of the first pile. Brief tests in 1973 and 1974 had indicated that a large number of bones might be present in this area. Conditions for excavating had improved, since the reservoir levels had been high enough to flood the area and soften the alluvial deposits, which during the previous excavation had been of cement-like consistency. The reservoir is periodically fed by spring and summer irrigation runoff water, and in fall and winter the

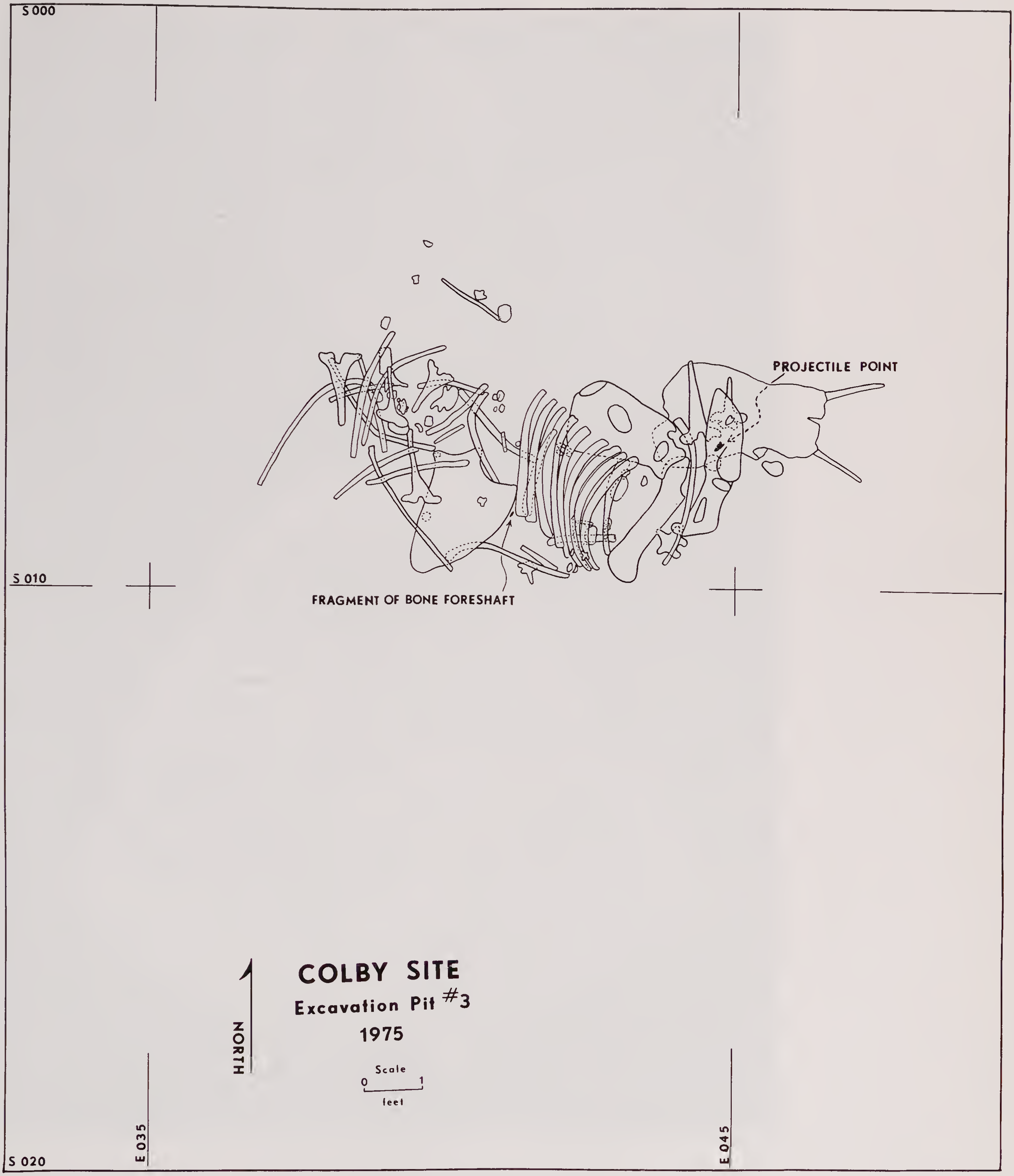


FIGURE 3.11. Bone distribution map of the remainder of bone pile 2 at the Colby site.

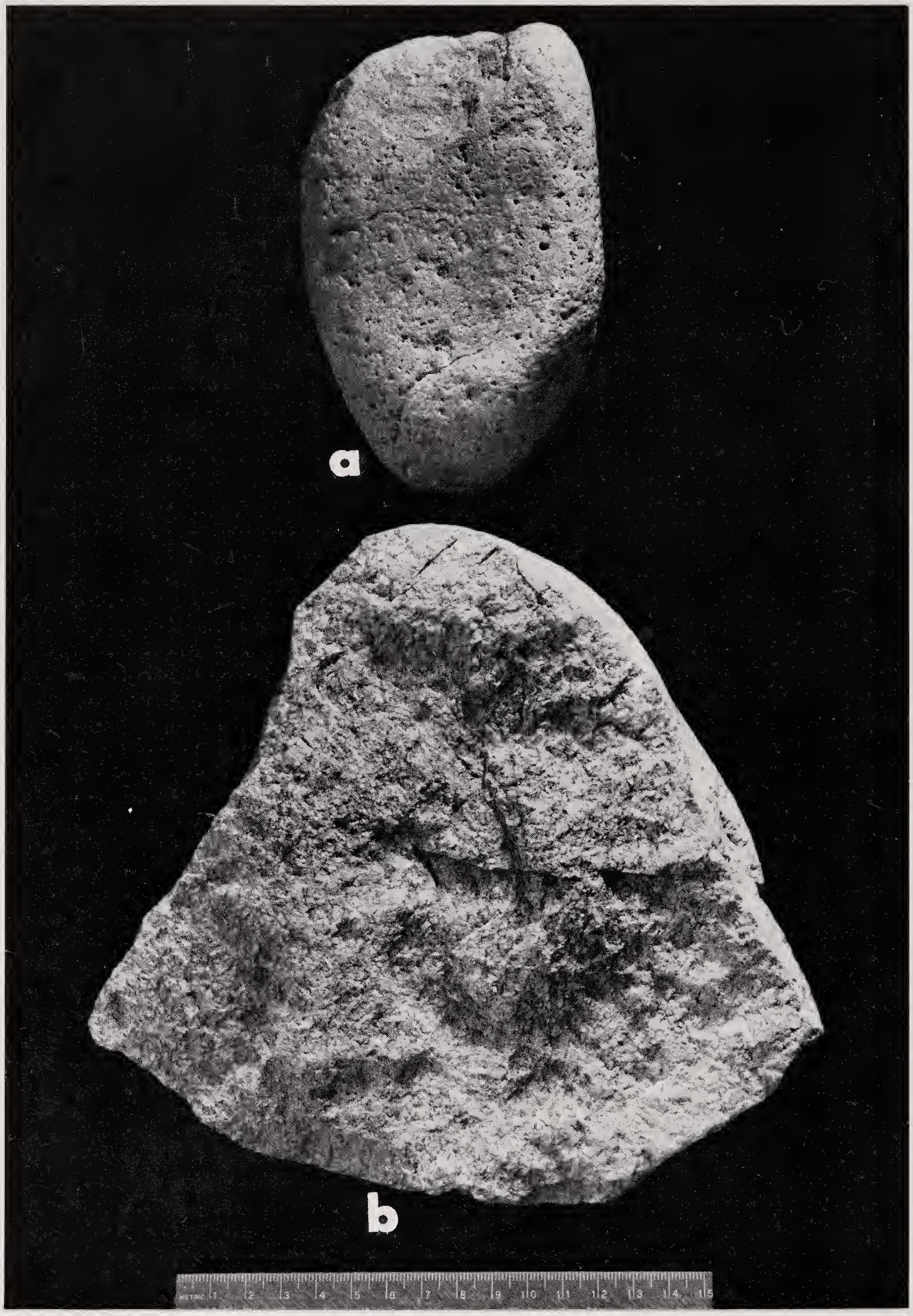


FIGURE 3.12. River boulder tools from the Colby site.

water level drops several feet through seepage and evaporation, allowing the site to become exposed in the spring and early summer.

The final result of excavations in this area was the discovery of another artificially stacked pile of mammoth bones (Figure 3.8). Like the first pile, it contained parts of at least three mammoths. Because the overburden was thicker here than over the first pile, the bones were better preserved. The bones of two of the mammoths were from young animals, judging from size and ossification; an articulated scapula and humerus belonged to a third, slightly older but not completely mature animal (the ossification of the epiphyseal ends of the humerus was more advanced than on any other long bones recovered, but it was not yet complete). As in the first pile, there were three left scapulae and two rights, indicating at least three animals.

The bone pile was centered on the sloping bank of the arroyo, although part of the bone pile was scattered out into the old arroyo bottom. The bone distribution suggested that runoff water in the arroyo subsequent to piling of the bone undercut part of the pile and resulted in considerable slumping, but most of the pile had never been moved from its original position. In addition, it could not have been too long after slumping of the bone pile that the bones were covered with alluvium. Otherwise the bones would not have survived, especially under the rather poor conditions of preservation. Just how long the mammoth bones could have remained exposed and still be preserved is conjectural. They could probably be exposed longer than those of smaller animals but even bones of a large animal such as a horse or a cow have to be covered within a year or so in order to achieve articulation of units and good bone preservation. In addition to this, immature bones with unossified epiphyses are less likely to be preserved than mature bones.

We do not know why the old arroyo filled with alluvium or what caused the present arroyo to be located several feet east of the old arroyo for a distance of nearly 1000 feet. The bone piles were undercut by water action indicating that some runoff water flowed through the old arroyo after the bones were stacked. This amount of undercutting, however, could have happened during a single gully-washer or spring runoff period. The situation reversed shortly afterward and the arroyo filled with alluvium. Again, we do not know whether any of the cultural activity was directly or indirectly connected with these geological changes. As was the case with some bison kills in arroyos, the large quantity of mammoth bones may have caught debris and caused the arroyo to change course, but it is difficult to comprehend how it could have changed its course for a distance of nearly 1000 feet.

The bone pile was apparently built around a unit consisting of part of the left side of the nearly mature mammoth. The unit consisted of 11 ribs along with the articulated scapula and humerus (Figure 3.10). The first three or four ribs were not in place but apparently had been and had slipped to the arroyo bottom after the bones were piled. There is no way to determine whether this unit lay where it was butchered or was moved there after butchering. There seems no doubt but what the rib cage and articulated scapula and humerus represent a deliberately prepared part of a single animal. Although deteriorated somewhat, the stages of bone ossification and relative position of skeletal units strongly indicate previous association of rib cage and articulated scapula and humerus.

If the partial rib cage and the articulated scapula and humerus were indeed placed in the bone pile as a complete unit, which is strongly suggested, it raises questions as to the degree of utilization of the animal by the hunters. There is a good deal of flesh between the rib cage and the scapula and we might wonder why a substantial quantity of meat such as this was not used. The fact that the unit was articulated suggests that the persons involved had deliberately placed the unit there without any intention of removing the flesh from the bones.

Half of a pelvis was placed upright against the articulated scapula–humerus, the ilium resting on the ground. Another left scapula was laid against the half-pelvis. An articulated radius–ulna lay on top of the partial rib cage but it is from a different animal than the one belonging to the articulated scapula–humerus. A femur must have originally been on top of the scapula–humerus since the unossified head is still there but the remainder slipped to the bottom of the old arroyo.

Placed directly on top of the bone pile was the skull of a young mammoth with articulated mandibles, with the atlas slipped a few inches from the articulated position. Four other cervical vertebrae had slipped toward the bottom of the pile. The remainder of the bone pile was somewhat scattered and consisted of three more scapulae, a matching tibia and fibula almost in articulated position, the other half of the pelvis, a femur, a humerus, a number of ribs and vertebrae, and both front and rear foot bones. Unossified epiphyses of bones were scattered throughout. Four bones other than mammoth were found and three of these appear to be artifacts. These will be described later.

This conglomeration of bones seems to have been deliberately stacked by some human agency. Directly underneath the upright half-pelvis was a complete projectile point (Figure 3.4d) of the same general type as the other three recovered at the site. The point had to be there before the bone was placed there. It clearly proves the involvement of humans but raises questions as to the nature of this involvement, for the point could have been placed there deliberately or it could have come to be there accidentally.

The pile of bones may have been a meat cache. The partial rib cage and articulated scapula and humerus were part of a butchered unit that probably contained several hundred pounds of meat. It was deliberately placed there, the other bones were stacked around it, and the skull was placed on top—whether for short-time protection from carnivores or longer-term frozen storage or yet another purpose is conjectural. For some reason the cache was never opened. The first pile of bones can be regarded as a similar cache that was opened and the meat utilized. This would explain the dispersed nature of the first bone pile.

A test trench between the two bone piles revealed several mammoth bones, including part of the tusk of a mature animal (Figure 3.13). For a discussion of the species of mammoth involved see Appendix 2.

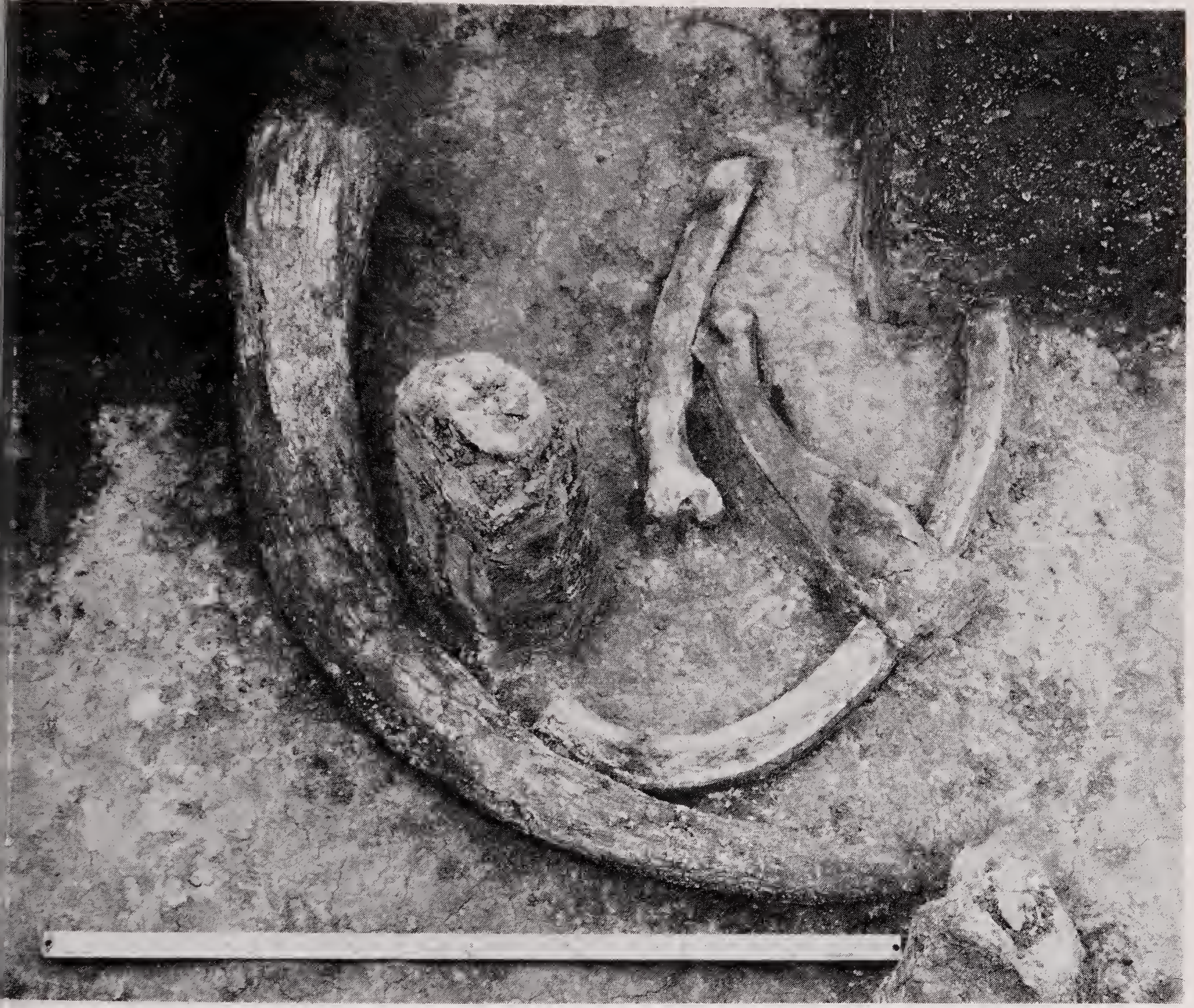


FIGURE 3.13. Tusk from a mature mammoth and other mammoth bones from a test trench at the Colby site.

ARTIFACTS RECOVERED FROM THE COLBY SITE

Four projectile points have been recovered to date from the Colby site, as I have mentioned. All are fluted, and on three specimens there is clear evidence that the step-fractures had been removed. This was done by driving flakes from one blade edge; consequently part of the end of the flute was removed also. Three of the specimens have rounded corners; the corners of the fourth (Figure 3.4c) are considerably less rounded. One (Figure 3.1a, b) has a deep basal concavity; this feature is less pronounced on the others. One (Figure 3.4c) demonstrates unmistakable reworking of the distal end.

The point found under the pelvis in the second bone pile is flaked to the extent that the original fluting is nearly obliterated, but whether this is a reworking or merely the finishing flake sequences of an original specimen is not known. Two of the specimens (Figure 3.4c, d) have extremely sharp points—almost certainly designed for effective penetration. All are ground on the base and for about one-third of the blade edges. All of the matrix around the second bone pile was water-screened but no tool sharpening or use flakes were recovered.

The materials used in the four projectile points are local. Three (Figure 3.4a–d) are of a chert that comes from the Permian Phosphoria Formation that is exposed on the lower western slopes of the Bighorn Mountains, at a distance of about 37 miles from the site. The fourth is of a chert common to the Mississippian Madison Formation exposed higher in the mountains. The small flake tool (Figure 3.1c) associated with the first bone pile was also of Phosphoria chert. Some flakes were of this same chert whereas others were of quartzite and a few were of cherts unidentified as to source.

Two unmistakable bone tools did appear in association with the second bone pile. One was made from the humerus of an artiodactyl the size of a deer or mountain sheep. The bone had both ends removed and a lengthwise section removed by grooving to form a tool reminiscent of a double-ended flesher. Warping and deterioration of both ends make exact identification improbable (Figure 3.14). A bone chopping tool was made from the distal radius of a camel. The animal was not quite mature and the epiphysis was not completely ossified (Figure 3.15). The artifact is reminiscent of similar tools found in later contexts. These tools were made of bison tibia and, less commonly, other long bones and were used extensively in bison butchering. The camel bone tool was made by smashing the radius on the posterior side close to the distal end. This resulted in a sharp point along the exterior lateral edge where the bone is extremely thick. Although somewhat weathered, the point of the tool demonstrates use. Functionally it is identical to bison tibia choppers and may have been superior during actual use because of the extreme thickness of the camel bone compared to bison. A spiral fracture confirms breakage of the bone while fresh and that it was not a dried out one.

At the base of the bone pile was a fragment of what may have originally been a bone foreshaft (Figure 3.1d). The bone is tapered for a distance of 21 mm at one end. The total length of the fragment is 45 mm. A groove about 1 mm deep and just over 1.5 mm wide extends lengthwise from the end of the taper. Whatever its function, it apparently was formed by grooving a bone lengthwise and splitting out a long segment. The bone could have originally been a metatarsal of some ungulate, since a remnant of what may be the vascular groove is present. If so, it could be antelope since the ulna of an extinct antelope was recovered near the first bone pile. The tarsal of a modern antelope is similar but about 1.5 mm thinner than the bone used for the possible foreshaft. The identification as part of a foreshaft is conjectural but grooving the bone is unmistakable. The artifact in question could be something else but the tapering on one end suggests a foreshaft.

A short distance from the bone pile and not in actual association but in the same alluvial deposit was a stone chopper made from a slab of granite. The working edge demonstrates considerable use. The actual working edge is blunt and use was made of sharp right-angle edges formed by the end and the sides (Figure 3.12b). The stone is alien to the site area and might have been a large river cobble. Under a scapula in the bottom of the old arroyo was a flat sandstone cobble that demonstrates use and may have been some sort of an abrading tool. Several meters down the old arroyo from the second bone pile

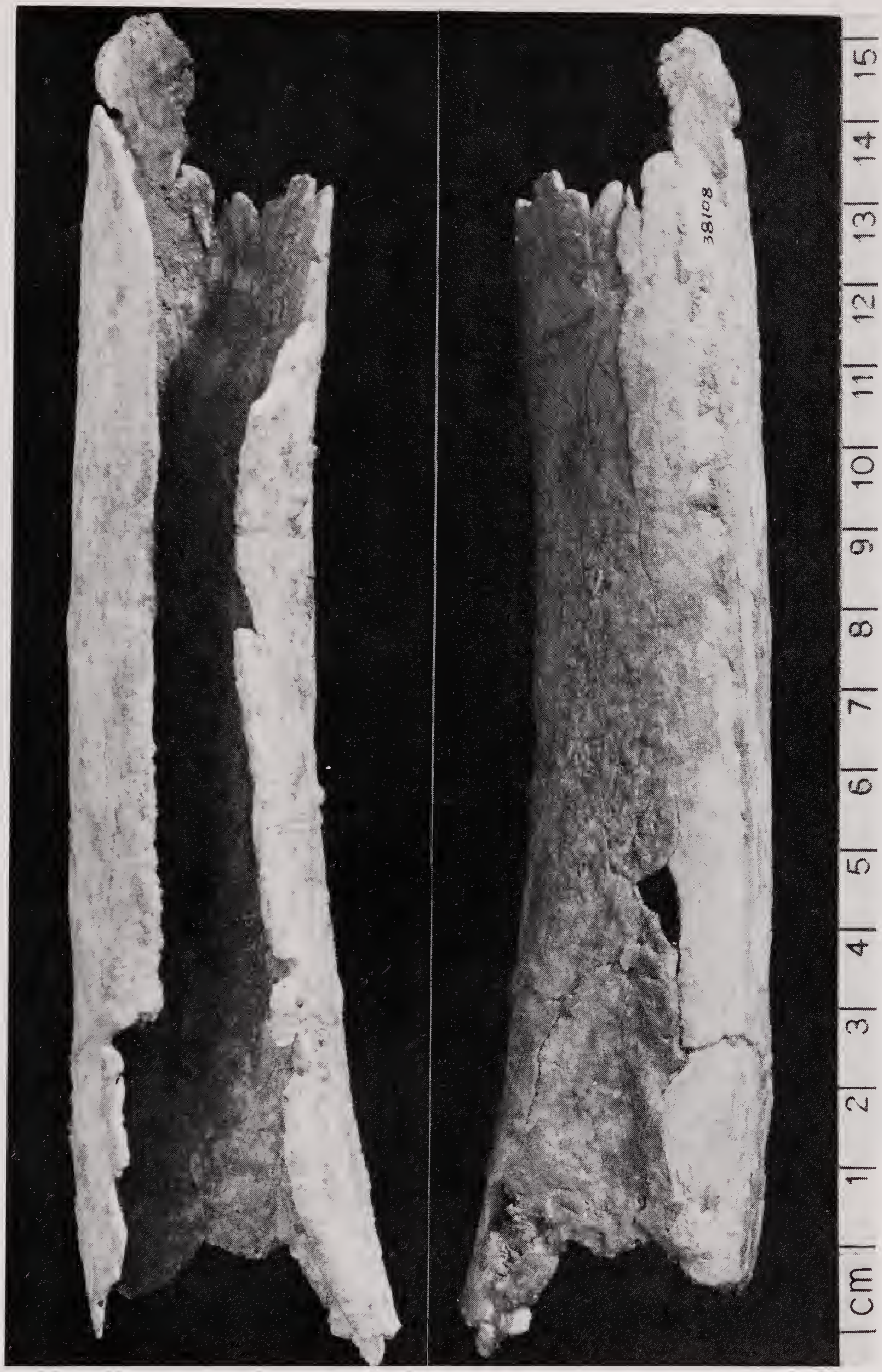


FIGURE 3.14. Double-ended scraper of unidentified bone from bone pile 2 at the Colby site.

was a fragment of long bone, unidentified but certainly not mammoth, that suggests a possible bone tool. One end is broken but the edges next to the break are worn smooth (Figure 3.16).

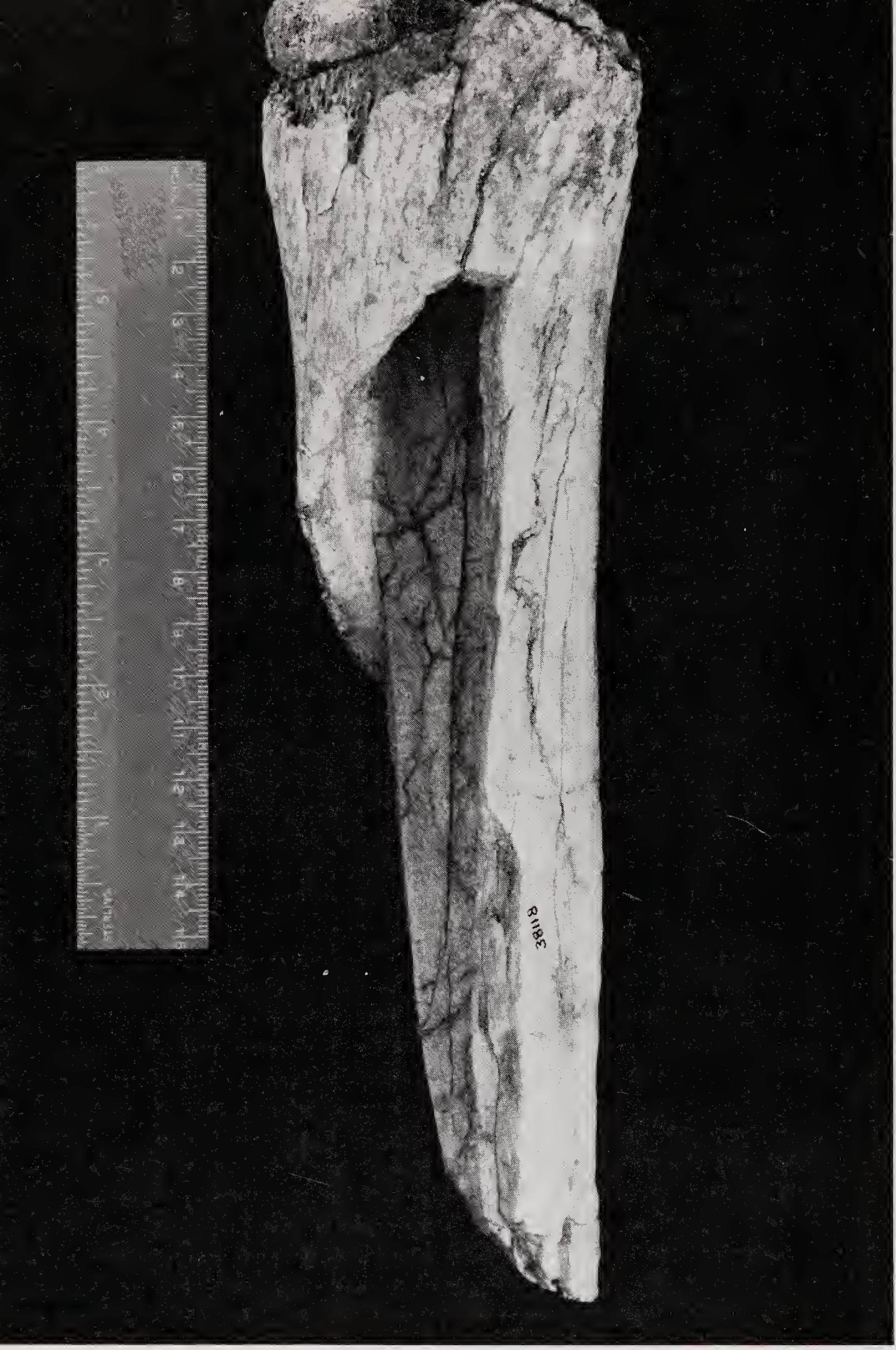


FIGURE 3.15. Camel radius chopper from bone pile 2 at the Colby site.

In the bottom of the old arroyo directly underneath one of the scapulae associated with the bone pile was a grinding stone shaped from a piece of hard sandstone. Both faces demonstrate scattered pecking and use striations (Figure 3.17a). One edge (Figure 3.17b) has been pecked and ground in a manner somewhat reminiscent of mano stones that appear in later time periods. Its original function is conjectural and it is tempting to suggest that it is a prototype of later-appearing mano stones. On the one hand, its presence near the bone pile suggests some relationship to mammoth butchering activities. It could have

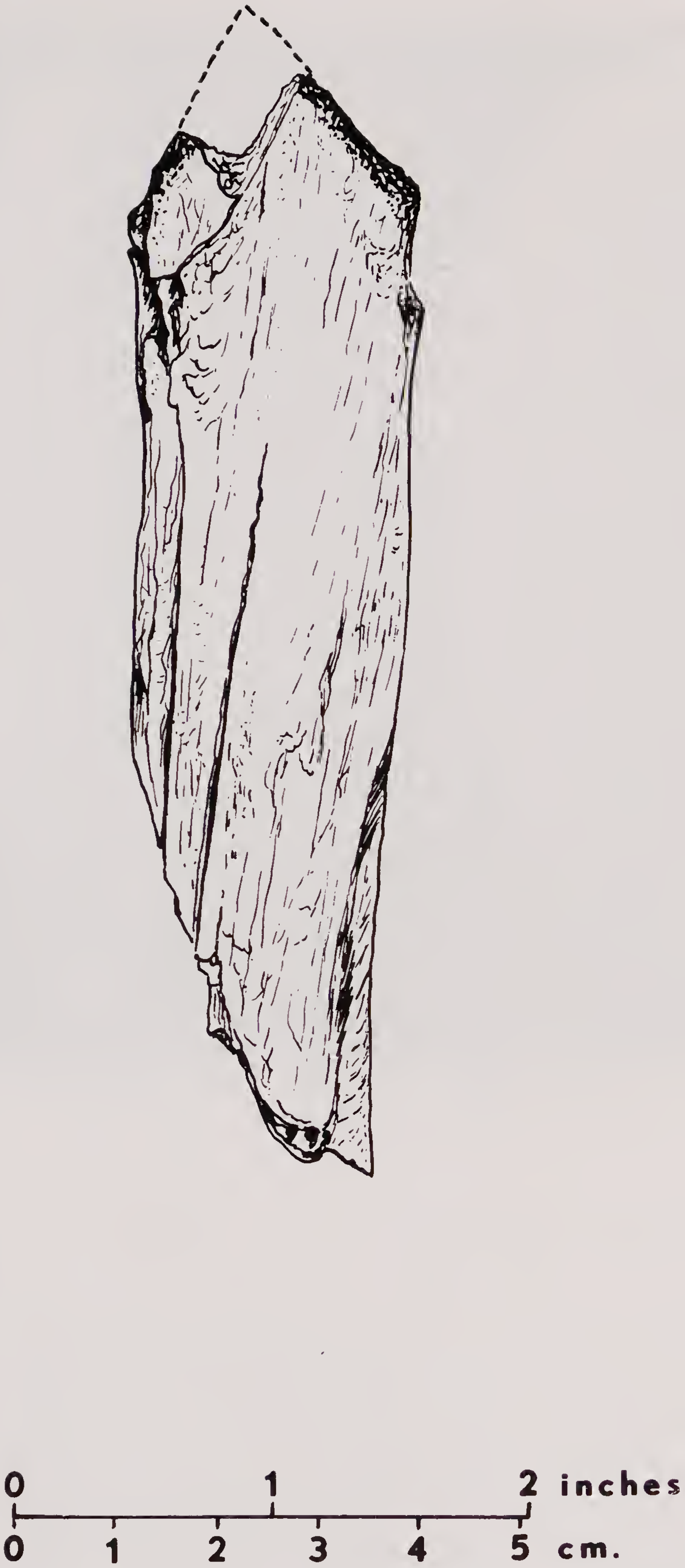


FIGURE 3.16. Possible bone tool of unidentified long bone from the Colby site.

been used in both manufacture and sharpening or other maintenance of bone and/or wooden tools. On the other hand, its presence in the arroyo bottom could indicate that it was derived from another part of the site through slumping of the arroyo banks. If so, it could be part of an assemblage used in nonbutchering activities. This opens the possibility for consideration of plant food utilization also.

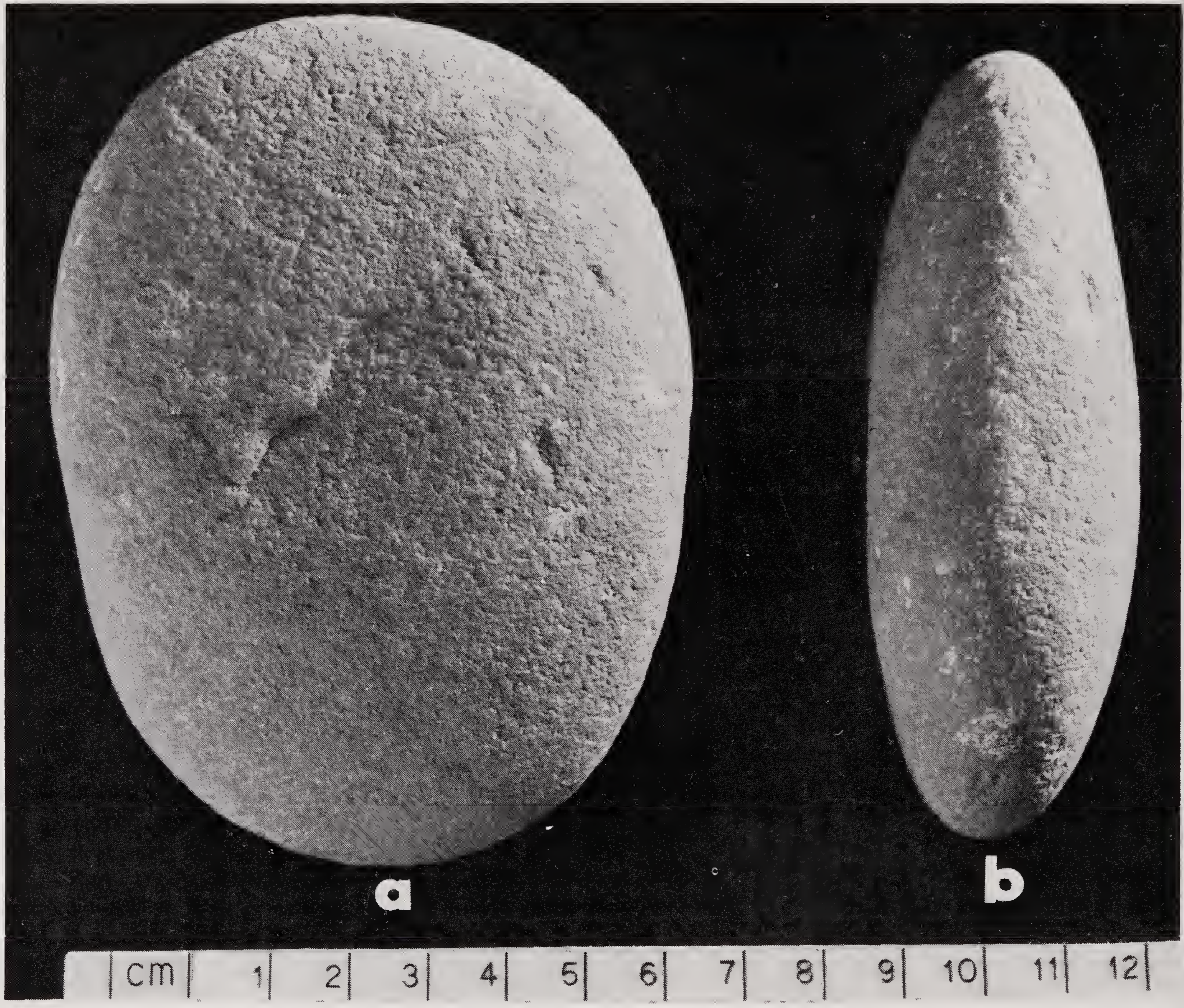


FIGURE 3.17. Grinding stone from bone pile 2 at the Colby site.

OTHER FAUNAL MATERIAL AT THE COLBY SITE

A metatarsal fragment from an immature animal was recovered alongside the second bone pile and it is probably *Bison* sp. Butchering is indicated because there is a green-bone break that can be reproduced in experimental butchering. A number 1 phalanx is also believed to be bison. A fragment of scapula resembles that of mountain sheep but positive identification is not possible. A fragmentary vertebra that is about the right size for bison was also recovered. Several jackrabbit (*Lepus* sp.) foot bones and broken long bones were also recovered. Several rib fragments recovered are the right size for deer or mountain sheep but are not identifiable.

Associated with the first bone pile was an ulna that is almost certainly antelope. The exact species is not certain but it is not *Antilocapra americana*. The olecranon was broken off in a manner suggesting butchering. Also recovered from this bone pile was a fetal metacarpal that closely resembles one from a 6–7 month bison fetus.

CONCLUDING REMARKS ON THE COLBY SITE

Observable results of human activity at the Colby site consist of two stacked piles of bones that represent a total of at least six animals, five immature and one approaching maturity. There is no indication that this bone-stacking was part of the butchering process; to the contrary, it strongly suggests activity secondary and even peripheral to any butchering. The paucity of both artifacts and evidence of artifact use associated with the bone piles further supports the idea that these bones were stacked after butchering and may have been for caching meat for later use.

We do not have any solid evidence as to who did the stacking and for what reasons. It could have been serious, deliberate effort by adults. Certainly placing a skull on top of a pile of bones seems deliberate. The fact that it was apparently done twice adds more significance and more strongly suggests a behavior pattern. Children playing could have achieved the same results as far as the actual gathering and piling of bones, but placing a mammoth skull atop a pile of bones requires coordinated effort, since even the smallest weighs hundreds of pounds.

The fortuitous discovery of a projectile point under one pile proves human association and possibly also indicates cultural activity. Its presence could have been accidental or deliberate. It could have been no more than a lost point, or it could have been deliberately placed there as some sort of offering. It is tempting to suggest that this bone piling activity was religious and of great significance to the human group, but lacking conclusive data other alternatives have to be given equal consideration.

The Colby site has so far provided a body of evidence concerning cultural activity related to a mammoth site. The actual nature of mammoth procurement at the site is not known and there is little apparent chance that very much more on the subject will be learned from the Colby site. All that remains of the original site is part of the alluvial fill in an old arroyo. Whether or not the old arroyo formed a natural trap or one that would have been functional through some modification is pure speculation. The site may not have been a trap at all but a place whereby some fortuitous combination of natural events, sick, wounded, or other animals collected. It is possible that at certain times of the year the exposed gumbo areas may somehow have caused mammoths to be lamed. Split-hoofed animals forced into such areas today are often lamed from gumbo being forced between their toes. During wet weather the sloping, dissected, gumbo areas may have been difficult for mammoths to navigate, since this terrain can be difficult for other animals in wet weather. An animal such as a mammoth might have been driven or somehow herded into a situation where it was trapped. Anyone doubting the problems of wet weather in gumbo country is invited to attempt to negotiate the Colby site area during a wet spring.

These suggestions are pure conjecture. Obviously the chance of observing an elephant in a gumbo condition in this area is remote. Unless better evidence is forthcoming, most of the actual details of mammoth procurement in the New World will remain in the realm of conjecture.

However, the evidence from the Colby site suggests that the Bighorn River valley and its environs probably supported a resident mammoth herd that was subjected to human predation. Judging from the immature animals at the Colby site, the predation could have had a serious effect on the resident mammoth population. We have been unable so far to locate further evidence of either the cultural group involved or other mammoths they killed in the area. This is not too surprising, considering the lateral movements of the Bighorn River and its tributaries and the high erosional factors present. Further evidence will probably appear with careful examination of Pleistocene terraces and exposures resulting from arroyo cutting.

THE MAMMOTH PROCUREMENT MODEL

The strategies for hunting African elephants may not be valid ones to apply to mammoth hunting but they are the only ones available that may be applicable. I do not believe that anyone can accurately describe the hunting of any species without firsthand knowledge of the subject. Having made this pronouncement I will now violate it—and propose some possibilities for mammoth hunting that are based on written sources and discussions with several persons familiar with African elephant behavior.

The analogy is not new. At a symposium on Paleo-Indian lifeways (Saunders 1975) the suggestion was made that the Lehner site, in southeastern Arizona (Haury *et al.* 1959) might have been a mass kill of a family of mammoths. This suggestion was based on the concept that the social organization of African elephants is based on a matriarch and her offspring. Many such families consist of around a dozen, sometimes fewer, animals and include several immature animals and the elderly females. Males usually leave or are forced out of the family at puberty. Citing that indiscriminately killing a member of a family of African elephants can bring the wrath of the family upon the hunter led to the proposal that the Lehner site represented the mass kill of a family of mammoths (Saunders 1975). The reason being that an entire family had to be eliminated at one time. If the two species in question were alike in behavior the idea has merit.

Elephant studies have proliferated in the past few years, partly as a result of overcrowding of the animals in game preserves in East Africa. Large numbers were cropped in order to prevent serious damage to the environment and these specimens provided a basis for detailed studies of many phases of elephant ecology (see, for example, Laws and Parker 1968; Laws *et al.* 1975). Other studies were made by more idealistic observers who do not favor present cropping methods (see, for example, Douglas-Hamilton and Douglas-Hamilton 1975). Regardless of any of these writers' views on the solutions for elephant overcrowding, their observations on animal behavior are valid.

African elephants normally range in small family units headed by a dominant female or matriarch. Large aggregations of elephants (up into the hundreds) are a phenomenon resulting from human pressure and occur at the point of contact between human and elephant populations. Each family unit has a strong attachment to a home range and covers all its range about once a month. The families are female-dominated and consort with males only in breeding season. Males either leave or are driven from the herd after puberty. Older males also tend toward the formation of local herds. No permanent attachments develop between mature bulls and family units. But strong bonds develop between cows in the family group, although the family may become too large and split. The survival of the younger animals depends on the strong bonds between the females.

The reaction of the family unit when alarmed is to "bunch" on the matriarch and to remain bunched until the alarm is past. If the matriarch runs, the rest of the family runs with her in bunched formation. If the matriarch becomes aggressive, so will the rest of the family. If the matriarch is shot, the rest will cluster around and actually try to help. On the other hand, matriarchs have been observed trying to lift fallen members of the family unit. In contrast, the normal male reaction to the same stimuli is flight on an individual basis. Only occasionally do bull groups demonstrate the bunching principle (Laws *et al.* 1975:161–163).

The bunching principle makes cropping of family units relatively easy. Herds are first bunched by giving an alarm. The matriarch is shot and the rest of the herd is killed as they cluster around her. The other females are killed first, and then the young are killed. There is little chance for any to escape. If a male is present, he is killed along with the matriarch since he is apt to take flight and others may follow. According to the persons cropping elephants, younger animals 200 m away from the family group will disregard rifle fire and try to rejoin the group (Laws *et al.* 1975).

From this it should be obvious that bunching behavior is no longer effective as protection. In fact, exactly the opposite is true. What was a mechanism for protection against predators, probably even humans with spears, serves the opposite purpose against men with rifles (see also Douglas-Hamilton and Douglas-Hamilton 1975:259).

If the mammoths were dispersed in family groups similar to those of African elephants, which seems likely, we can envision some of the factors the mammoth hunter had to consider and reconstruct a feasible hunting method.

First, direct confrontation of a mammoth family unit would have been unlikely, because the hunting group probably did not have the means to kill the entire unit quickly and efficiently.

Second, herding or driving the animals into a natural or artificial trap seems unlikely, considering the bunching tendency and the technology required to build a structure that would hold such animals.

Third, a better approach would have been for the hunters to familiarize themselves with the territory and the regular movements of the animals within the territory. The hunters could then watch for their chance, spear an animal when it was a short distance away from the group, and do it in such a way that neither the speared animal nor the rest of the family group was aware of what was happening. The spear was probably thrust into a vulnerable spot that would lead to the animal's death. Whether death took hours or days was of little concern.

Fourth, hunting mature males was an entirely different proposition. The males could have been in herds or alone and the family protection aspect would not have been a problem to the hunter. Also solitary females would obviously not have presented the problems of a matriarch in a family unit.

Fifth, mammoth hunting was carried out quietly, with the absolute minimum of excitement to the animals. The less the animals were aware of the hunters, the better the chances of success.

A working hypothesis for the Colby site based on the African elephant behavior model is that mammoths regularly and predictably moved through that part of the Bighorn Basin in family groups. Vegetation or terrain or both were favorable in the site area so that an occasional young animal (or perhaps more than one) could have been speared without undue excitement to the remainder of the group. As the group moved on, the wounded animal drifted into the vicinity of the arroyo, which may have formed a barrier of sufficient magnitude to stop the animal. Unable to negotiate the arroyo the mammoth simply laid down. All the hunters had to do was wait.

It is difficult to regard the Colby site as a single mass kill of a family unit, considering the probable reaction of a family unit faced with danger. A more plausible explanation is that the location provided the opportunity for the hunters to pick off an occasional animal in such a way that the remainder of the group was not alarmed. This kind of predation must have had serious effects on the viability of the resident mammoth population, considering the long period of mammoth gestation and the protracted period required for maturation.

4

The Folsom Occupation on the Northwestern Plains

The Folsom occupation represents what was apparently a successful hunting and gathering adaptation over a large geographic area in many different natural environments. The Folsom group is one of the most easily recognized of all prehistoric New World cultural groups because of a distinctive process in stone flaking technology; their fluted projectile point and the by-products of manufacture are certain cultural indicators. The Folsom site itself (Figgins 1927) indicates that Folsom hunter–gatherers were knowledgeable in the ways of bison procurement. I recently analyzed some of the osteological material from the original Folsom site excavations and on the basis of tooth eruption and wear concluded that the bison were killed within a short period of time. This suggests a communal kill. The time of year was apparently late fall or early winter—provided the calving period was the same as or very close to that of modern bison.

Folsom is widespread in its occurrence but large undisturbed sites are few. Lindenmeier (Roberts 1935, 1936) is one exception but, unfortunately, the data on hunting there are meager. A "bison pit" that yielded remains of at least nine animals has been described, but whether it was a single large kill of a communal nature or a number of separate kills over a period of time is not known. However, the amount of bone articulation described suggests a single-event kill situation. If it was a communal kill, the method employed is unknown since there is no reported record of any suitable geomorphic feature being present at the time of the operation. Evidence from the Linger site (Hurst 1943) and possibly also the Zapata site (Wormington 1957:30), both on the western slopes of the Rocky Mountains in the San Luis Valley of south-central Colorado, suggests bison kill sites. The Lipscomb site on the Southern Plains (Schultz 1943) with 14 articulated or partly articulated bison skeletons may be a communal kill. Analysis of the Lipscomb dentitions should yield information on the nature of the kill (whether a single event or several events over a period of time) and possibly also some information on seasonality. Bonfire Shelter (Dibble and Lorrain 1968) suggests bison jumping over a precipiece was known during the Folsom period. Except for Lindenmeier, all the kill sites mentioned are well to the south of the area considered in this chapter. However, the distribution of Folsom cultural materials leaves little doubt that bison trapping was occurring on the Northwestern Plains as well as on the Southern Plains.

A small, undisturbed Folsom cultural level was present at the Carter-Kerr McGee site near Gillette, Wyoming. The deposits contained bison bone, evidence of projectile point manufacture, and a number of stone tools. It is probably only a remnant of a much larger site and may have been close to a bison procurement site. The materials are as yet only partially analyzed.

Other known Folsom sites on the Northwestern Plains are quite rare, but surface finds of Folsom projectile points are a widespread occurrence. This suggests that the lack of sites may be largely the result of geological processes rather than a true gap in the cultural record. The MacHaffie site in Montana (Forbis and Sperry 1952) is an exception; it yielded Folsom projectile points and tools along with bison and other faunal materials. A number of Folsom sites are known besides Lindenmeier, but none of these evidence cultural materials actually in place. The Johnson site (Galloway and Agogino 1961; Wormington 1957:40) in extreme northern Colorado a few miles west of Lindenmeier produced projectile points, tools, and debitage. The Green River Basin in Wyoming has been a prolific area for Folsom surface finds of projectile points. The Morgan site is located about 30 miles east of the Finley site in an area of stabilized sand dunes in the Green River Basin at an elevation of about 7000 feet. Here both Folsom projectile points and evidence of manufacture rest on a sand-covered clay level, but they are mixed with other Paleo-Indian, Archaic, and Late Prehistoric cultural materials. About 30 miles south of Rock Springs, Wyoming, the Mud Springs site produced both projectile points and debitage from manufacture. Elevation here is also about 7000 feet and site evidence has been exposed by recent sand movements. Neither the Morgan site nor the Mud Springs site has been systematically investigated.

The North Platte River drainage has also produced a number of surface finds of Folsom points. One site about 10 miles north of Rawlins, Wyoming, seems to be a campsite. It is as yet uninvestigated. The site is in an area of considerable topographic relief at an elevation of about 7000 feet. The Hell Gap site in southeastern Wyoming produced a Folsom level (Irwin-Williams *et al.* 1973). Further north in the Cheyenne River drainage is the Brewster site

(Agogino 1972), another Folsom manifestation. Recent finds of Folsom projectile points and some debris from manufacture suggest small camps or projectile point manufacturing stations atop the Bighorn Mountains. This indicates a widespread Folsom occupation for the Northwestern Plains.

Another site that should eventually be of importance in interpreting Folsom culture is located in the northern part of the Bighorn Basin in central Wyoming. This is now known as the Hanson site, and one summer's excavation in 1975 plus preliminary testing during the fall of 1973 have provided information on what appears to be a large, undisturbed Folsom campsite.

THE HANSON SITE

The northern Bighorn Basin is an arid area lying directly in the rain shadow of the northern Absaroka Mountains. The Bighorn River flows north through almost the center of the basin and picks up several major tributaries from the Absaroka and Owl Creek mountains to the west and the Bighorn Mountains to the east. The northern end of the Bighorn Mountains is steeply faulted to the west toward the Bighorn Basin so that the mountain front is nearly vertical in places for several miles. Elevation increases from about 5200 feet at the Hanson site to almost 10,000 feet within a horizontal distance of less than 6 miles to the east.

Shell Creek is one of the major streams draining the northern Bighorn Mountains to the west. Several lesser streams flow into Shell Creek from the north and these begin at relatively high elevations, but because of the steepness of the mountain front they lack the drainage area to become very large. One of these streams, known as Beaver Creek, heads at the Bighorn Mountain divide and its different forks converge into a single small stream at the base of the mountains. Several usually dry arroyos that head in the arid badland country within the interior basin flow into Beaver Creek. One of these tributaries, Davis Draw, heads in sandstone country known geologically as the Cloverly Formation (Lower Cretaceous) and within a distance of a mile or so it cuts a deep narrow canyon through the sandstone of this formation. A short distance further it leaves the sandstone area and cuts through areas of the Thermopolis Formation shale (Lower Cretaceous) and here three distinct terraces are visible. It is at the edge of the uppermost terrace on the southeast side of Davis Draw that the Hanson site lies. Further back from the edge of the terrace the Folsom cultural level deepens as it is covered with increasingly deeper deposits of colluvium in the direction of the interstream divide. The exposure of the site may be a relatively recent phenomenon, judging from a lack of scatter of Folsom lithic materials over the arroyo scarp and on to the next lowest terrace. For further discussion of Hanson site geology, see Appendix 1.

The site locality is quite rough, especially to the immediate north into the area of deeply trenched sandstone canyons. (See Figure 4.1.) The dominant vegetation at the site is sagebrush (*Artemesia* spp.) although many alkaline soil

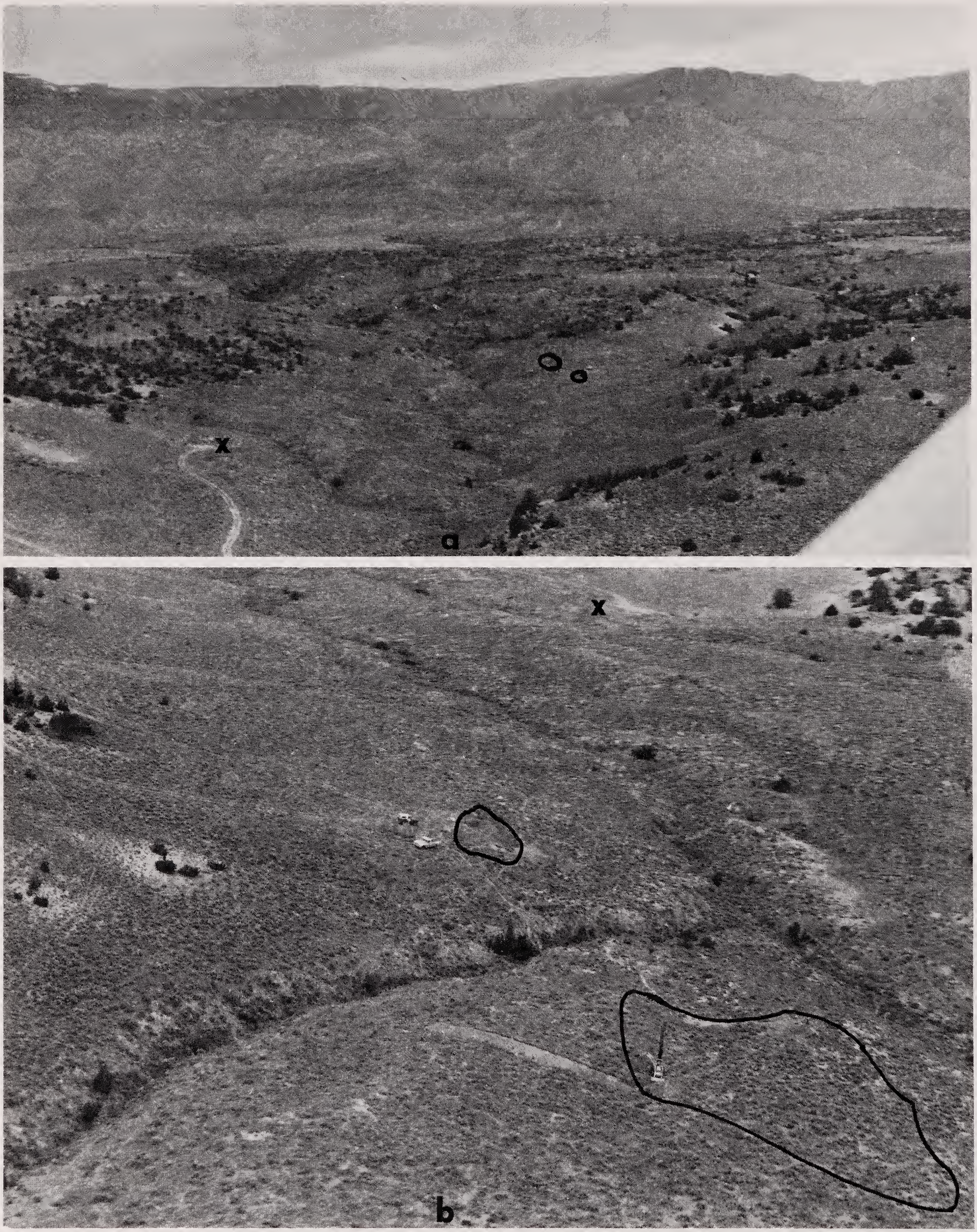


FIGURE 4.1. Aerial views of the Hanson site looking northeast (a) and west (b). Site areas are inside black lines. The X marks the same spot for better orientation.

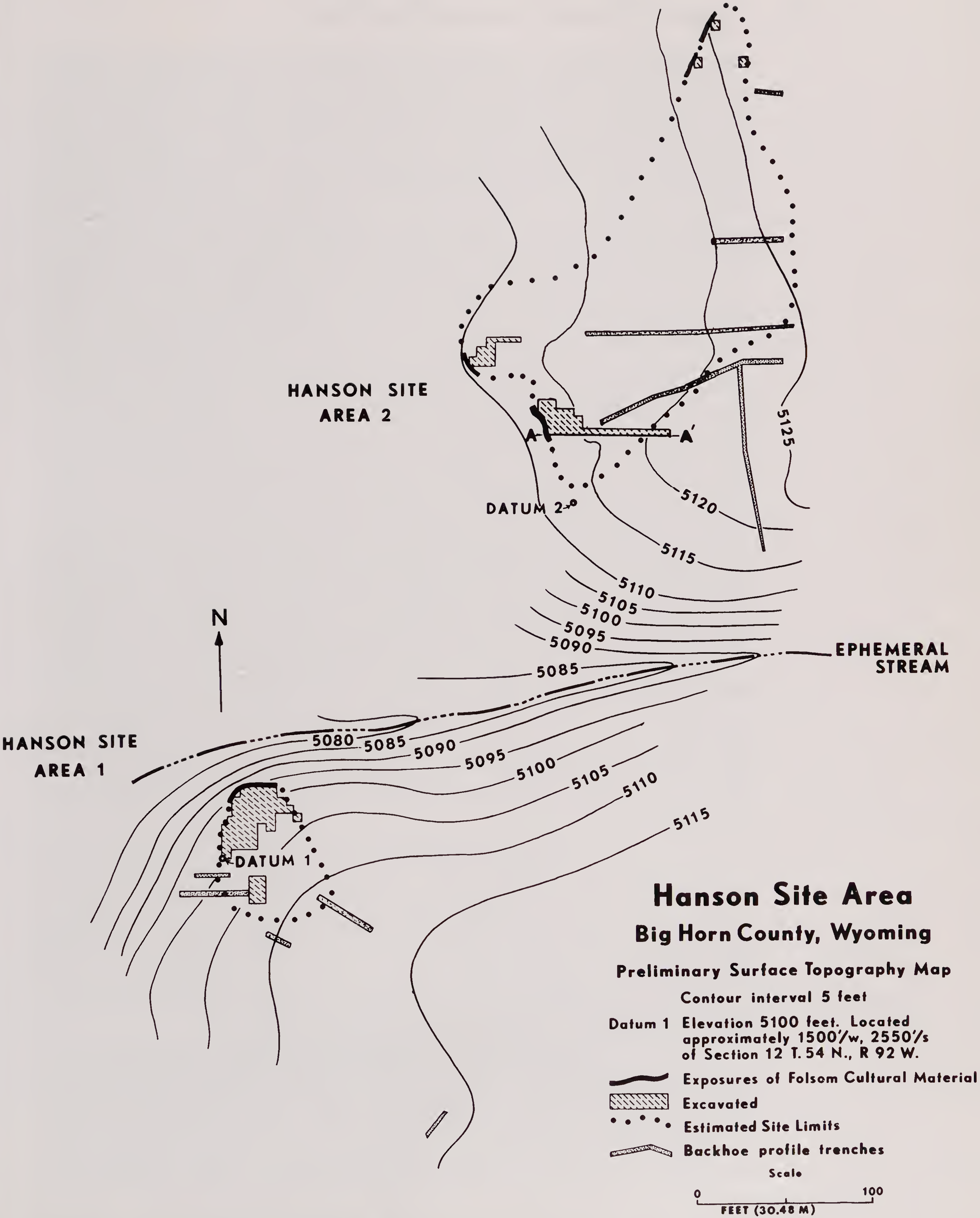


FIGURE 4.2. Preliminary surface topography map of the Hanson site.

outcroppings support greasewood (*Sarcobatus vermiculatus*). Juniper (*Juniperus* sp.) is dominant in places toward the steeper arroyo slopes and around sandstone outcroppings that also support occasional limber pines (*Pinus flexilis*) and ponderosa pines (*Pinus ponderosa*). In addition some sandstone areas support mountain mahogany (*Cercocarpus ledifolius*). Bunch grass, especially blue grama (*Bouteloua gracilis*), is interspersed between clumps of sagebrush but seldom forms a turf. Yucca (*Yucca glauca*) appears in sandy, well-drained places. In the bottom of Davis Draw to the north of the site are a few cottonwoods (*Populus angustifolia*) indicating an intermittent spring.

There are two known separate areas that make up the Hanson site at this time and it is not at all likely that the full extent of the Folsom occupation in the immediate area is presently known. A small, higher-order tributary enters Davis Draw from the east and splits the Hanson site into two separate areas (Figure 4.1). The part of the site to the south (Hanson 1) is where the first discovery was made and the test excavations carried out in the fall of 1973 (Figure 4.2). Extensive evidence of stone flaking was found and all stages of production from core reduction to tool and projectile point manufacture were present. Tools, fire, and bone fragments suggest extensive campsite activity.

The northern part of the site across the small arroyo was discovered in the spring of 1975 shortly after the beginning of fieldwork at Hanson 1. Hanson 2 has subsequently proven to be the largest part of the site. The known evidence of Folsom activity appears for a distance of about 82 m along the edge of the top terrace. Backhoe trenches reveal Folsom deposits for a distance of at least 53 m back from the terrace edge in one location and about 20 m in another.

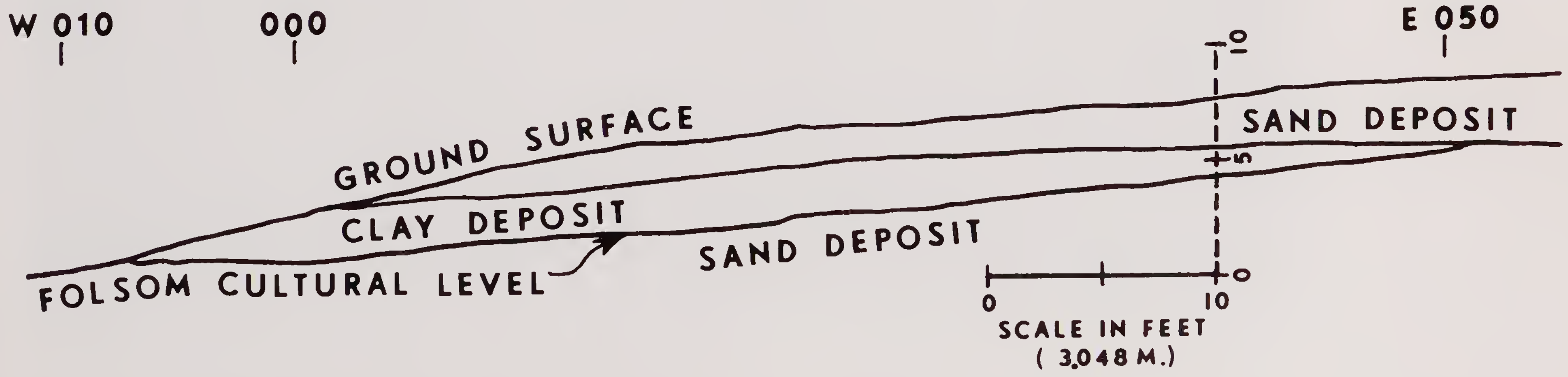
Main site features to date consist of activity areas believed to represent former lodge structures. Hard-packed, sandy floors define what are believed to be vaguely circular living structures although no discernible postholes outline the floors. One of these possible lodge locations provided evidence of two packed floors suggesting more than one period of use. No evidence was present to indicate whether the period between occupations was a season, a year, or several years.

Only two of these possible lodges have been completely investigated. The absence of postholes around their circumference is not too surprising since known Plains Indian tipis do not have poles extending more than a few centimeters below ground level. The above ground part of the lodges might also have been of a horizontally laid log construction, similar to the dome-shaped lodges with five or more sides common to the area and believed to be of Shoshonean origin. There was also no evidence of stones encircling the lodges, which was common to Archaic cultural groups.

The lodge floors investigated appear to have been covered deliberately with a thin layer of sand from 1 to 2 cm thick, and extensive pure sand deposits are located within 100 m of both areas of the site. There is evidence of intensive heat but very little charcoal has been found. There were no fires defined by pits or circles of stone—although areas of the floors are oxidized to a reddish color for depths of as much as 5 cm in places. There are many calcined bone fragments, also suggesting considerable heat. For some unexplained reason there apparently was nearly complete combustion of materials with little charcoal preserved. A small sample from Hanson 1 yielded a date of 10,700 B.P. ± 670 (RL–374). A small sample from Hanson 2 yielded a date of 10,080 B.P. ± 330 (RL–558). There is no reason to suggest that the discrepancy between the two dates represents that much true age difference between the occupations of the two areas of the site.

Another area was tested that also gave evidence of similarly packed floors, although the two levels there were not as distinct as in the first area. These tests were made where debitage was exposed along a northerly extension of the terrace edge, mostly to determine if the debitage was of Folsom origin and to gain some idea of the extent of the site. The presence of channel flakes and some distinctive tools along the base of a distinctive gray clay stratum leaves no doubt that it is Folsom. A backhoe profile trench was dug back into the terrace in an attempt to determine the extent of the site. The stratigraphy in the trench revealed that the Folsom occupation level was indeed contained within and near the bottom of the stratum of gray clay mentioned and that it finally disappeared some distance back from where it was exposed at the edge of the terrace (Figure 4.3). Another cultural level, not yet identified, rests directly on top of the gray clay stratum. A single projectile point reminiscent of what has been called Meserve (Wormington 1957) indicates that the level may be Paleo-Indian. A small amount of Plains Archaic cultural material was found on the present surface of the terrace. Below the Folsom level the backhoe trench revealed highly mineralized deposits containing bison bone but no cultural evidence. Judging from the mineralized nature of the bone, we believe it to be several thousand years older than the Folsom levels; it is a paleontological manifestation.

FIGURE 4.3. Schematic profile of the Hanson site demonstrating relationships between depositional units.



The Hanson site, although only partially investigated, tells us something at least about Folsom occupation of the Northwestern Plains. The site was apparently a campsite and suggests that many of the usual campsite activities were going on. The most obvious activity was flint knapping and the site provides evidence—from core reduction to tools and finished projectile points—of all the basic processes. The site and its environs within a radius of a few miles are particularly rich in good to excellent quality cherts and quartzites and most of this was utilized. The exact quarry sources that the Folsom groups obtained materials from have not been determined because all known quarries show evidence of being worked and all the known cultural groups through time utilized the same materials. So far we are unable to distinguish quarrying activities of the Folsom group from those of other earlier and later groups. In addition to this, the Folsom group was utilizing a good deal of material that existed as smoothed and polished cobbles commonly referred to as gastroliths or stomach stones and probably glacial and stream terrace deposits as well. Gastroliths are abundant in the Jurassic Morrison Formation, which is widely exposed in the general area of the site and much of the interior Bighorn Basin. Much of the site debitage and some tools demonstrate remnants of the highly polished gastrolith surfaces.

The Morrison Formation is particularly productive of a distinctive gray-to-tan fine-grained quartzite that continually erodes out and occurs in nodular form. Other facies of the Morrison Formation yield high-quality chert, both translucent and opaque varieties. All are found in quantity in the Hanson site debitage.

However, the most common material used in the manufacture of projectile points and end scrapers was an opaque red chert that occurs in the Phosphoria Formation (Permian). Other facies of the same formation yield a material of almost equal quality but bluish gray sometimes mottled with brown or white. This material occurs in nodular form and is found mostly atop the Bighorn Mountains where the formation is exposed over large areas—especially where it is dissected by gullying. Other exposures of this material occur along the faulted mountain front. The Madison Formation (Mississippian) also produces chert of excellent flaking quality and these sources are likewise atop the Bighorn Mountains, since the Madison Formation underlies the Phosphoria. Most streams have cut through the various formations and much flaking material is available as stream boulders and cobbles. So there was an abundance of good flaking material available over much of the area.

Most of the tools recovered at the site were made on flakes, occasionally on blades, and less frequently cores and broken bifaces. These include end scrapers, side scrapers, gravers, borers, and a wide variety of retouched flake tools used for cutting and scraping purposes. Flaked stone choppers of various sizes and shapes were recovered. A number of broken bifaces were recovered and whether these represent a preform stage for projectile point manufacture is not fully resolved. Some of these do suggest projectile point preform stages (Figure 4.4a, d, e) but others (Figure 4.4b, c) may be something else. However,

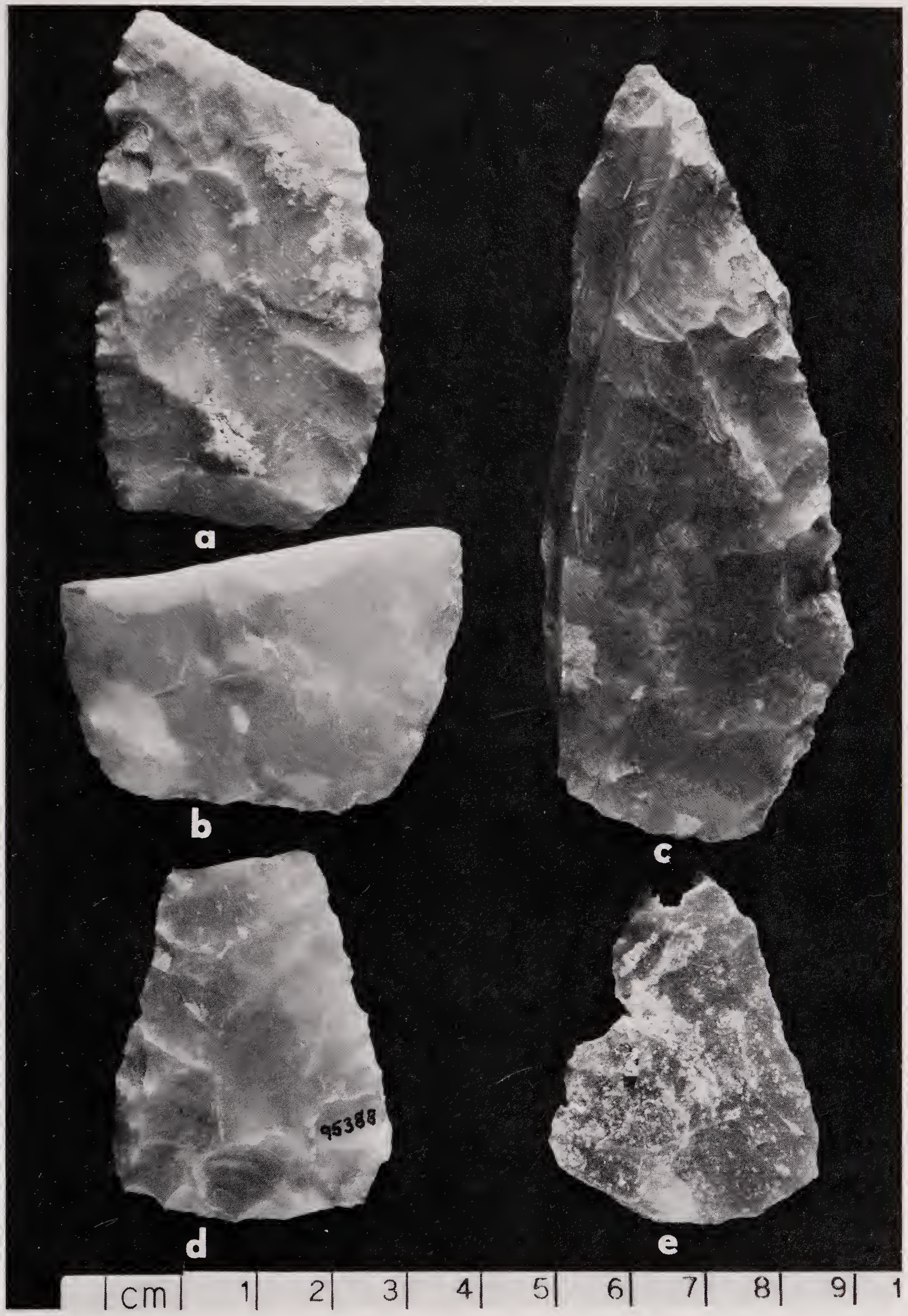


FIGURE 4.4. Bifaces from the Hanson site.

actual identifiable biface tools have not yet been recovered. The utilization of broken bifaces was minimal. There is one rare example provided by a biface broken so that the edge formed by the break formed a good cutting edge. The biface was modified by pressure flaking (Figure 4.4c) and the original blade edge of the biface was deliberately dulled, probably to protect the hand during use.

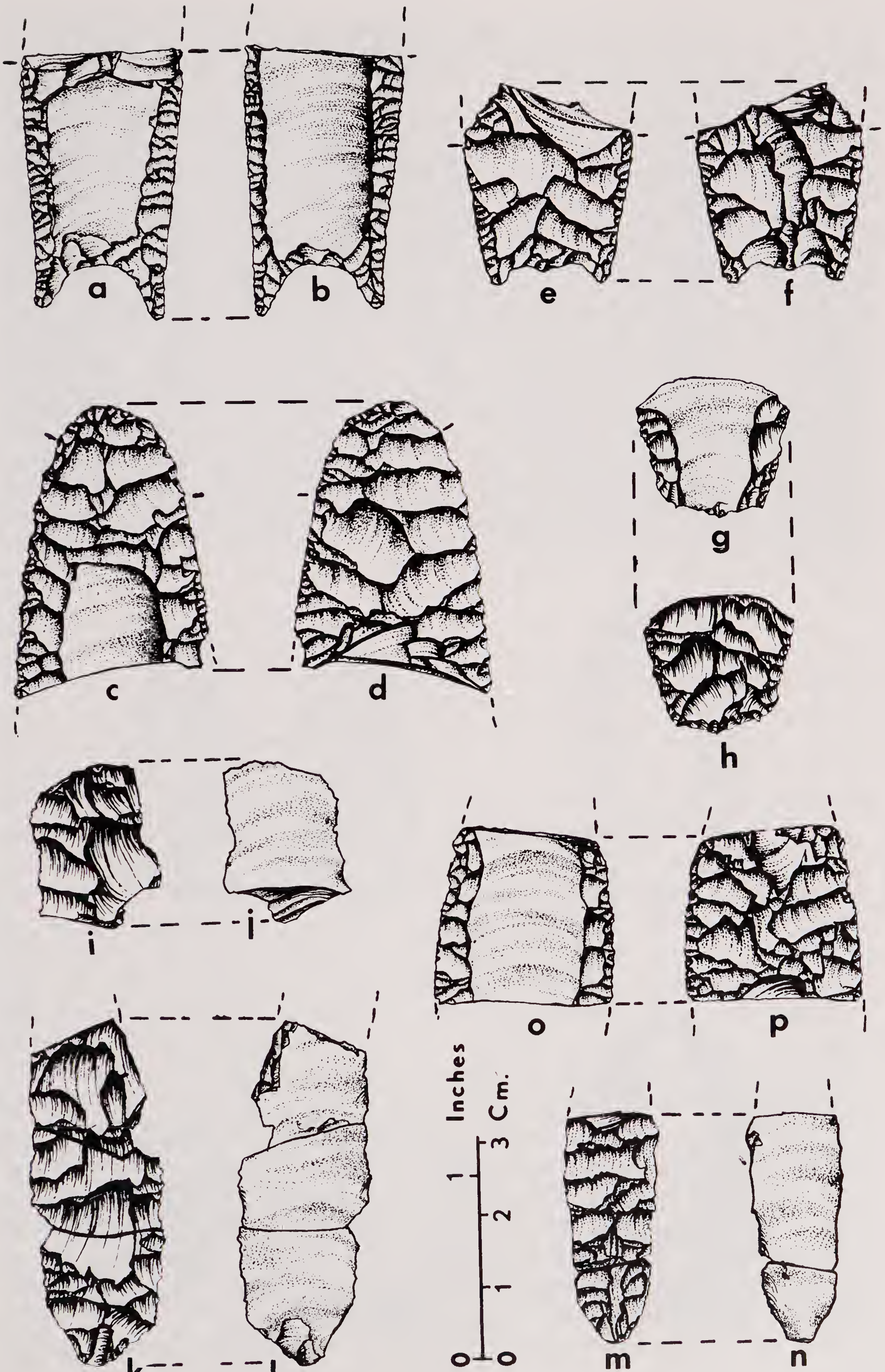
Lacking entirely to date at the Hanson site are knapping tools of either percussion or pressure types. This seems anomalous considering the amount of debitage present, which would lead one to expect at least some broken or worn-out hard and soft hammers. Possible indirect evidence of knapping tool use consists of a hard sandstone abrading tool, which could have been used in platform grinding. Striking platforms on nearly all flakes demonstrate extensive grinding.

There are a number of crude heavy tools that appear to be hammerstones or combination hammerstone–choppers but not for flint knapping. Some are made of black diorite whereas others are of limestone, both locally available. They are similar to tools used to break the heavy long bones of bison in butchering sites of later periods.

Projectile point manufacture involved biface reduction to a final stage characterized by a blunt, ground distal end and a concave base with a carefully prepared striking platform for channel flake removal. After the removal of the first channel flake, the striking platform was prepared for the channel flake on the opposite face. The distal end was sometimes broken off in the channeling process. The final shaping of the projectile was done by careful pressure flaking. Snapped-off ends of preforms with rounded and blunted ends are common (Figure 4.5c–d). In this case, part of one channel flake that was driven from the preform in Figure 4.5c was recovered (Figure 4.5i–j). Channel flakes usually shattered into several pieces upon removal but several were partially reconstructed (Figure 4.5k–l, m–n). A broken preform with one long, wide channel on one side and a short channel on the opposite site was recovered (Figure 4.5o–p) and it was snapped off just before the end of the shortest flute.

There is evidence of many failures in the final production stages of Folsom projectile points. Channel flakes did not always carry straight and either hinged out too soon or did the opposite and split through the preform (Figure 4.5g–h). Buckling of the preform sometimes occurred during removal of either channel. This is characterized by a transverse break that sometimes removed a flake in one or both directions from the break on the face of the preform opposite the direction of buckling. These flakes can sometimes be mistaken for true channel flakes. Diagonal breaks across one corner of the base were also common, as were as a wide variety of breaking and shattering. A recently published work on Folsom projectile point manufacture at the Adair–Steadman site in Texas (Tunnell 1975) describes the same kind of stone-working problems that appear at the Hanson site.

FIGURE 4.5. Projectile points (a, b, e, f) and projectile point manufacturing remains (c, d, g–p) from the Hanson site.


a
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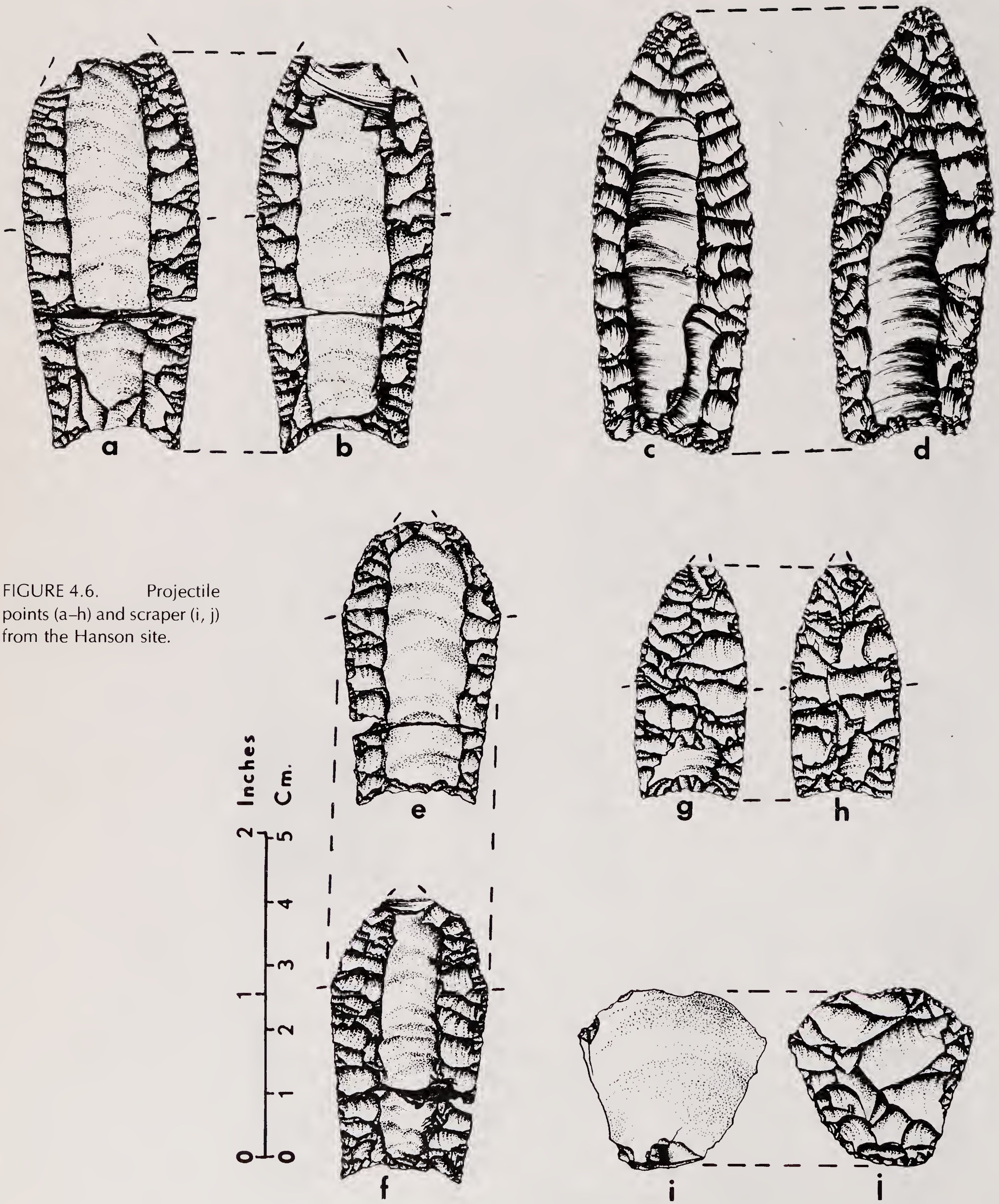


FIGURE 4.6. Projectile points (a–h) and scraper (i, j) from the Hanson site.

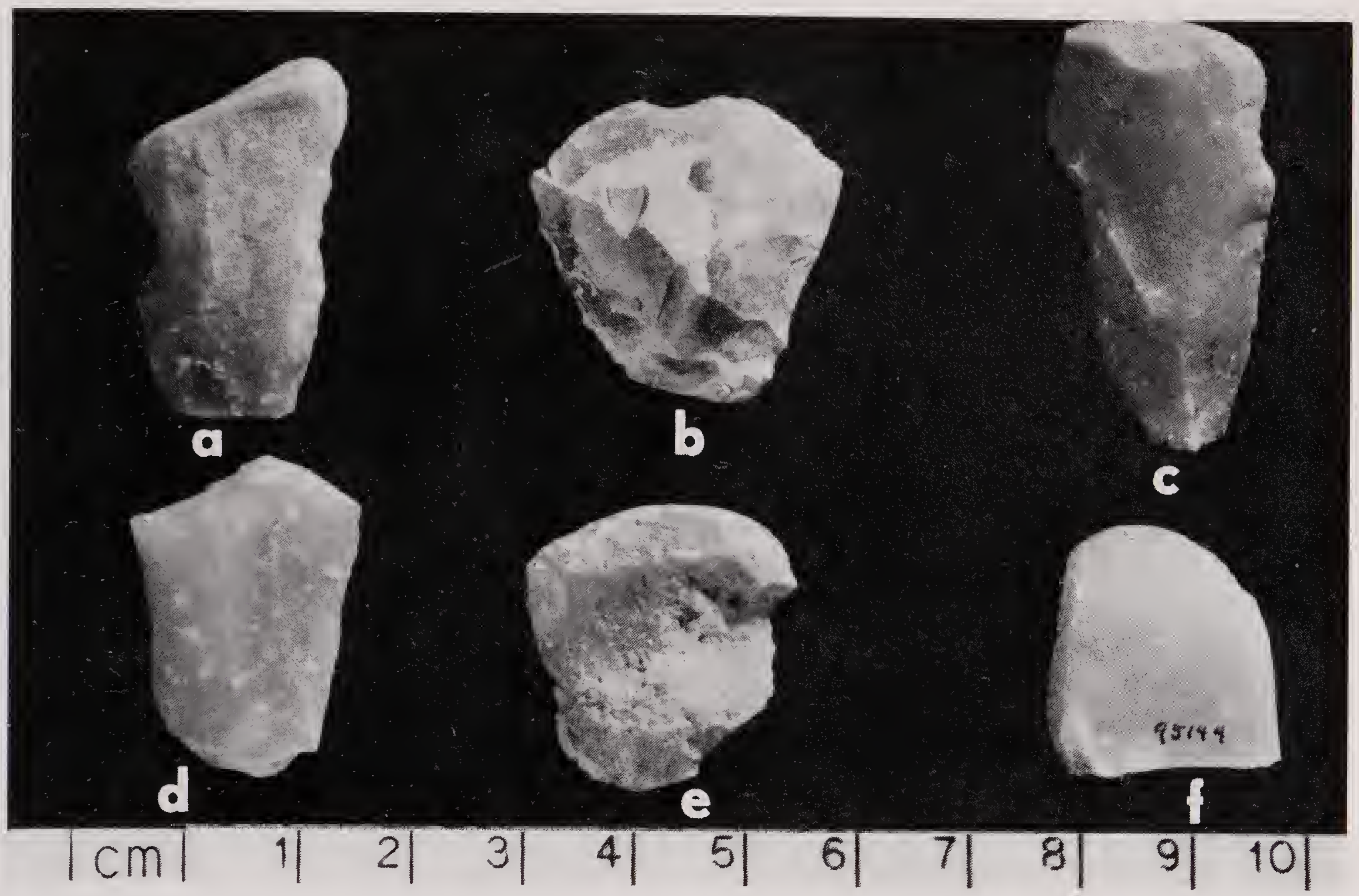


FIGURE 4.7. Scrapers from the Hanson site.

Some projectile points demonstrate a minimal amount of pressure retouch after channeling (Figure 4.6a–b, e–f). Others demonstrate a steep pressure retouch reaching to the edge of the channel flake scar (Figure 4.5a–b). In the latter case, the retouch probably represents more than one stage of pressure flake removal. It is postulated that some utilized projectile points were brought back to the site, probably to reclaim the attached haft. At least two demonstrate heavy impact flake scars (Figure 4.5a–b; Figure 4.6a–b). One is impacted toward the point and is broken transversely toward the base, suggesting that the point might have been contained in a split haft. After the point broke close to the base, the channels held the pieces together until they were removed from the haft. Both pieces were recovered at the site (Figure 4.6a–b). Similar breakage occurred on another point but the distal part was subsequently reused as some sort of tool (Figure 4.6e–f).

One specimen was fluted on both sides but was discarded before it was completed (Figure 4.6c–d). The fluting process may have been considered inferior, or the point may have been lost. Another specimen was reworked to the extent that the original fluting was almost obliterated (Figure 4.6g–h). Several apparently complete specimens were never fluted. On one of these even a false striking platform is present (Figure 4.5e–f) for the flute although it was never completed for flake removal. However, a fine secondary flaking had been applied to the blade edges, which were ground smooth toward the base as they were on all the completed specimens. This suggests the specimen had been completed and there was no effort to remove either flute. The secondary

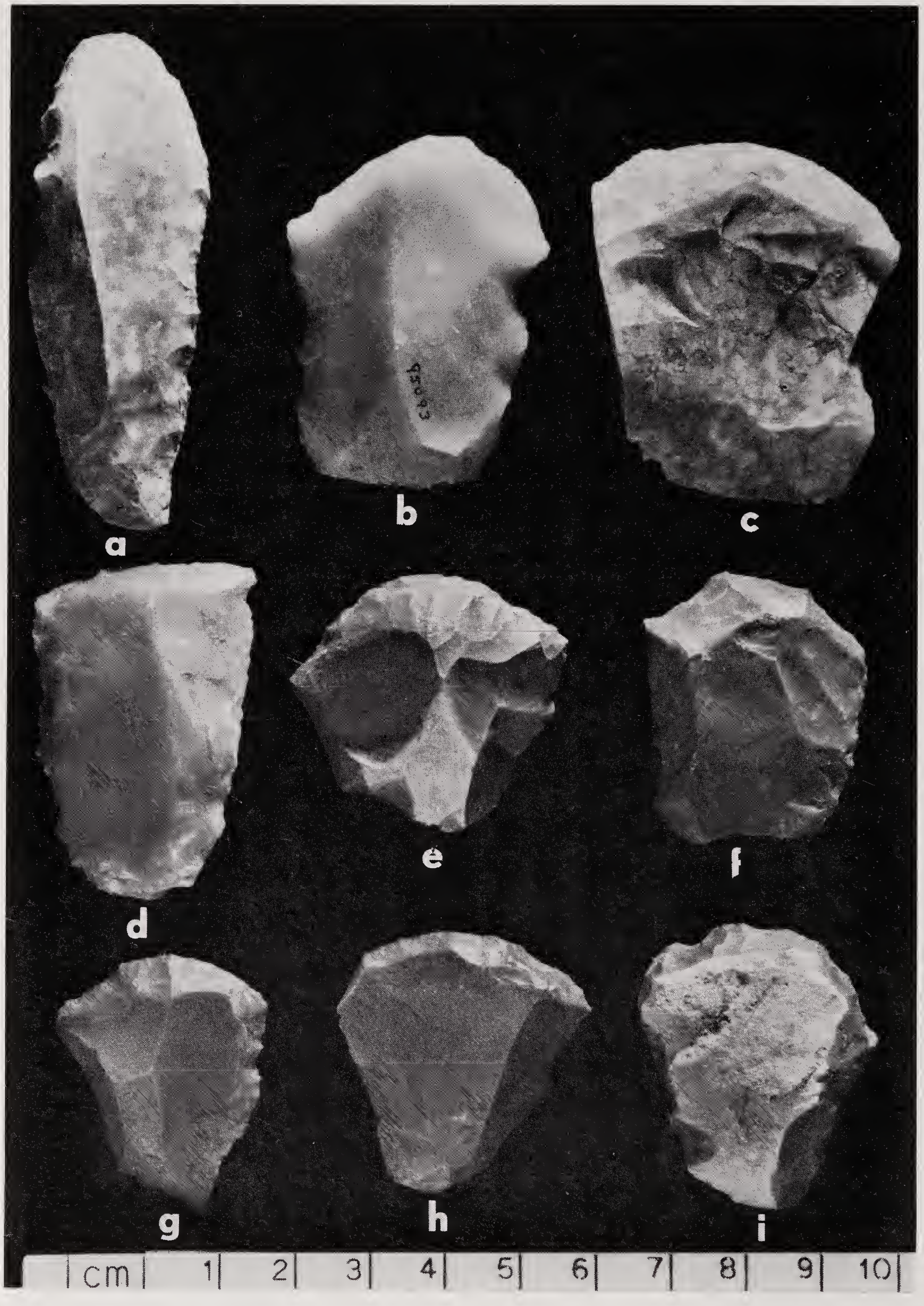


FIGURE 4.8. Scrapers from the Hanson site.

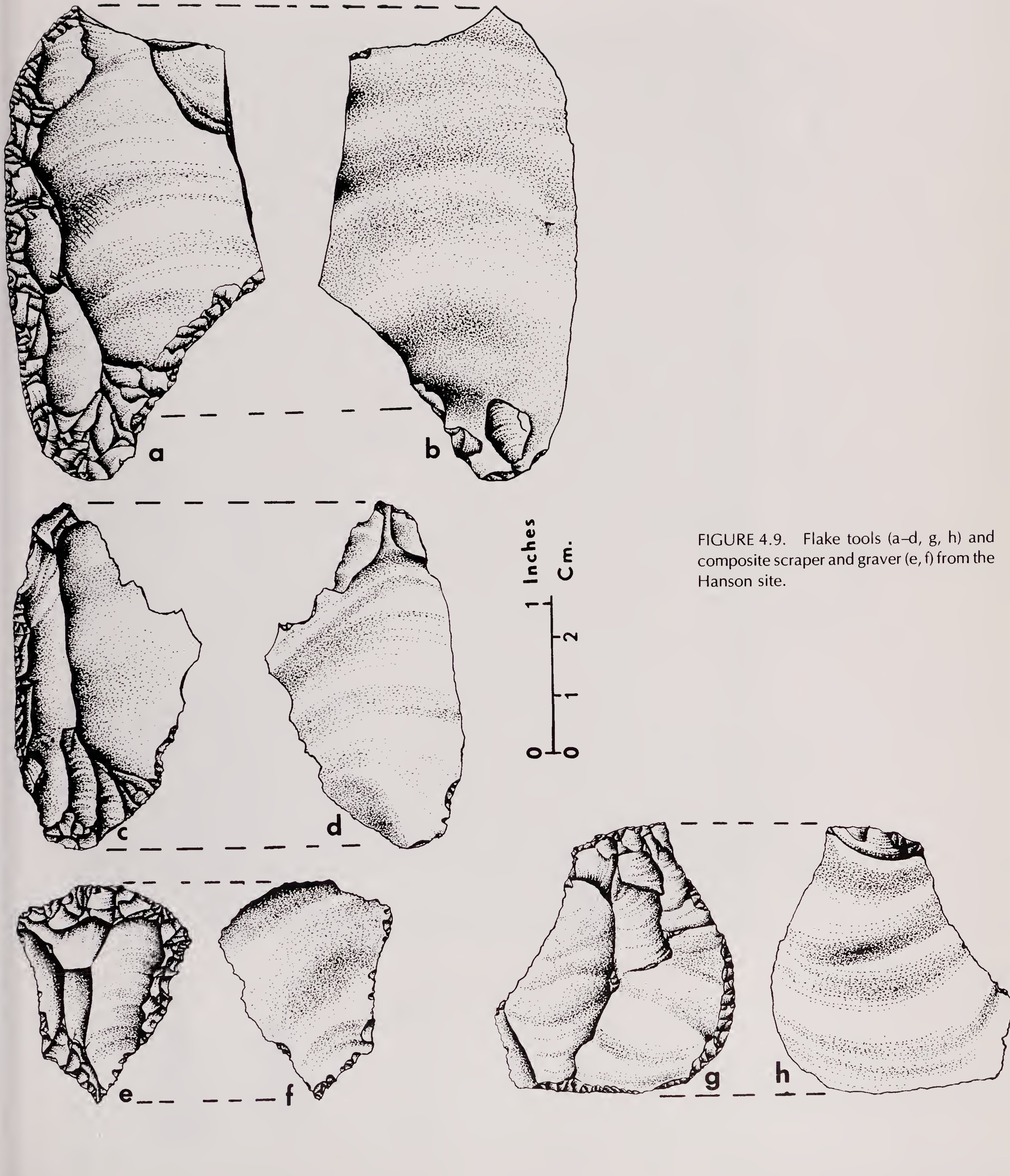


FIGURE 4.9. Flake tools (a–d, g, h) and composite scraper and graver (e, f) from the Hanson site.

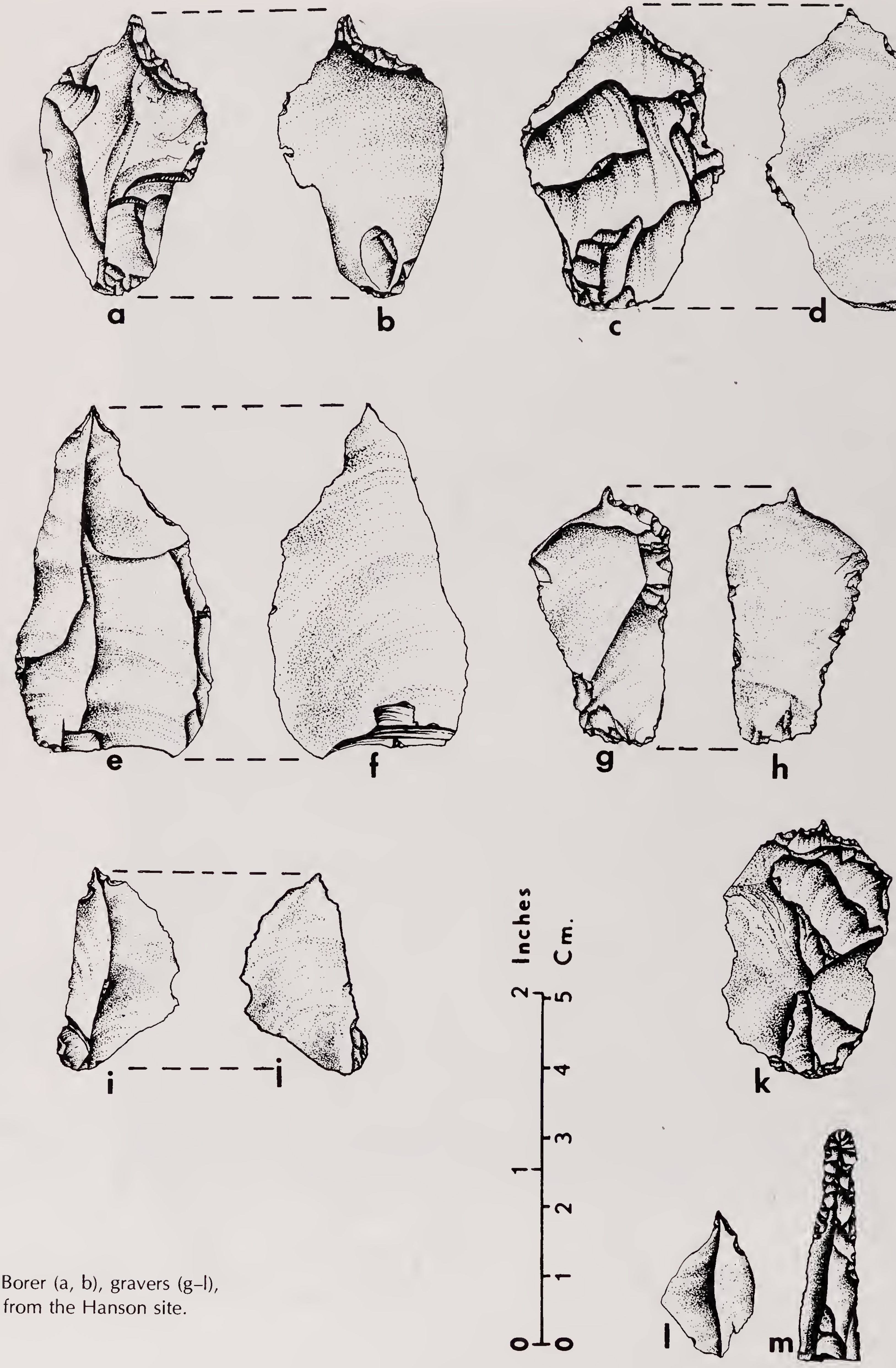


FIGURE 4.10. Borer (a, b), gravers (g–l), and scraper (m) from the Hanson site.

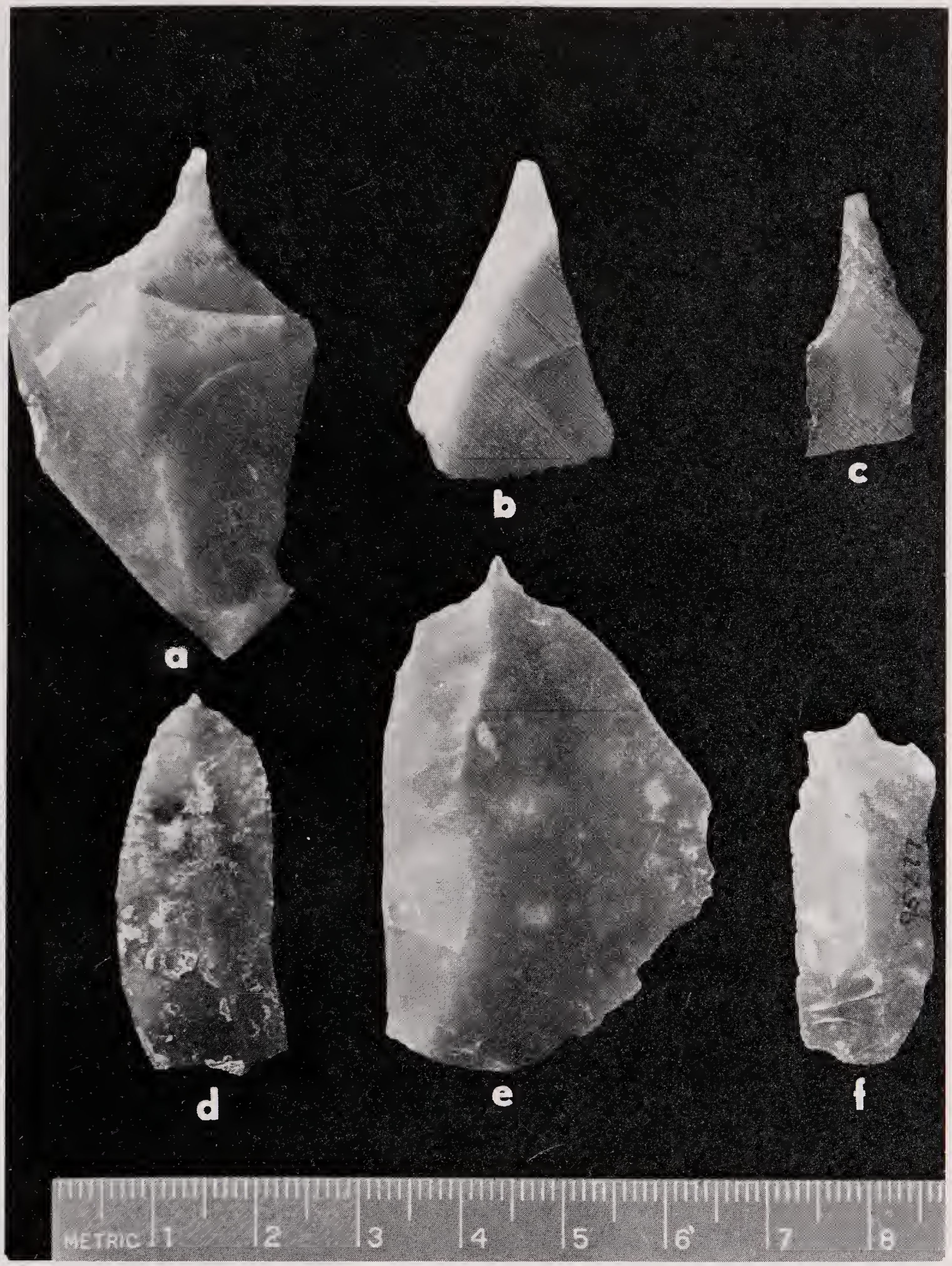


FIGURE 4.11. Gravers from the Hanson site.

retouch of blade edges leaves this specimen somewhat reminiscent of Midland projectile point type.

End scrapers of various styles were plentiful at the Hanson site. A definite spur may be evident at both corners of the working edge (Figure 4.6i–j; Figure 4.7b; Figure 4.8c, e) or it may be more prevalent on one corner (Figure 4.7c–e; Figure 4.8c, d, f–i). On one specimen the spur is actually a small, rounded

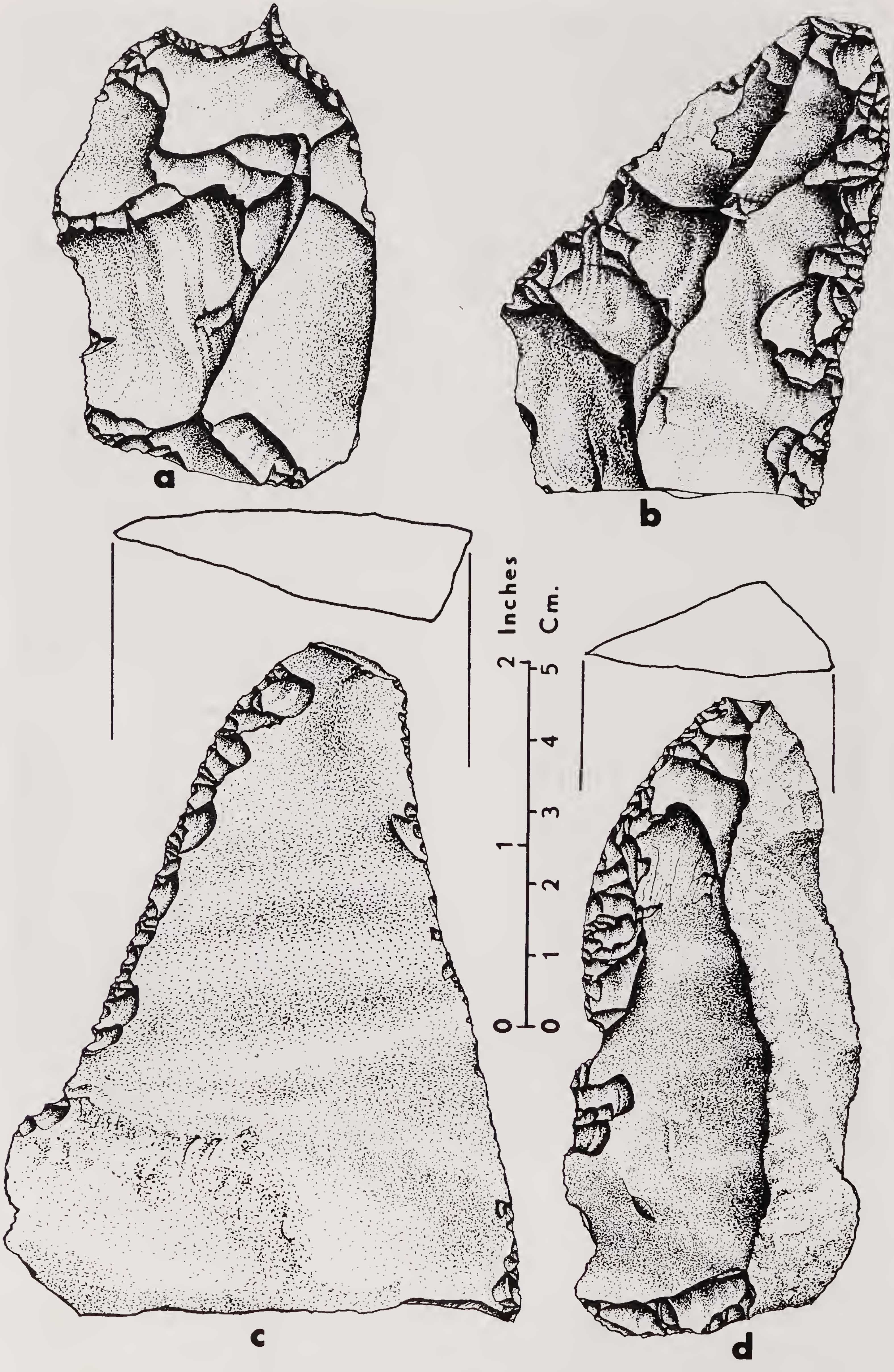


FIGURE 4.12. Composite graver and spokeshave (a) and flake tools (b–d) from the Hanson site.

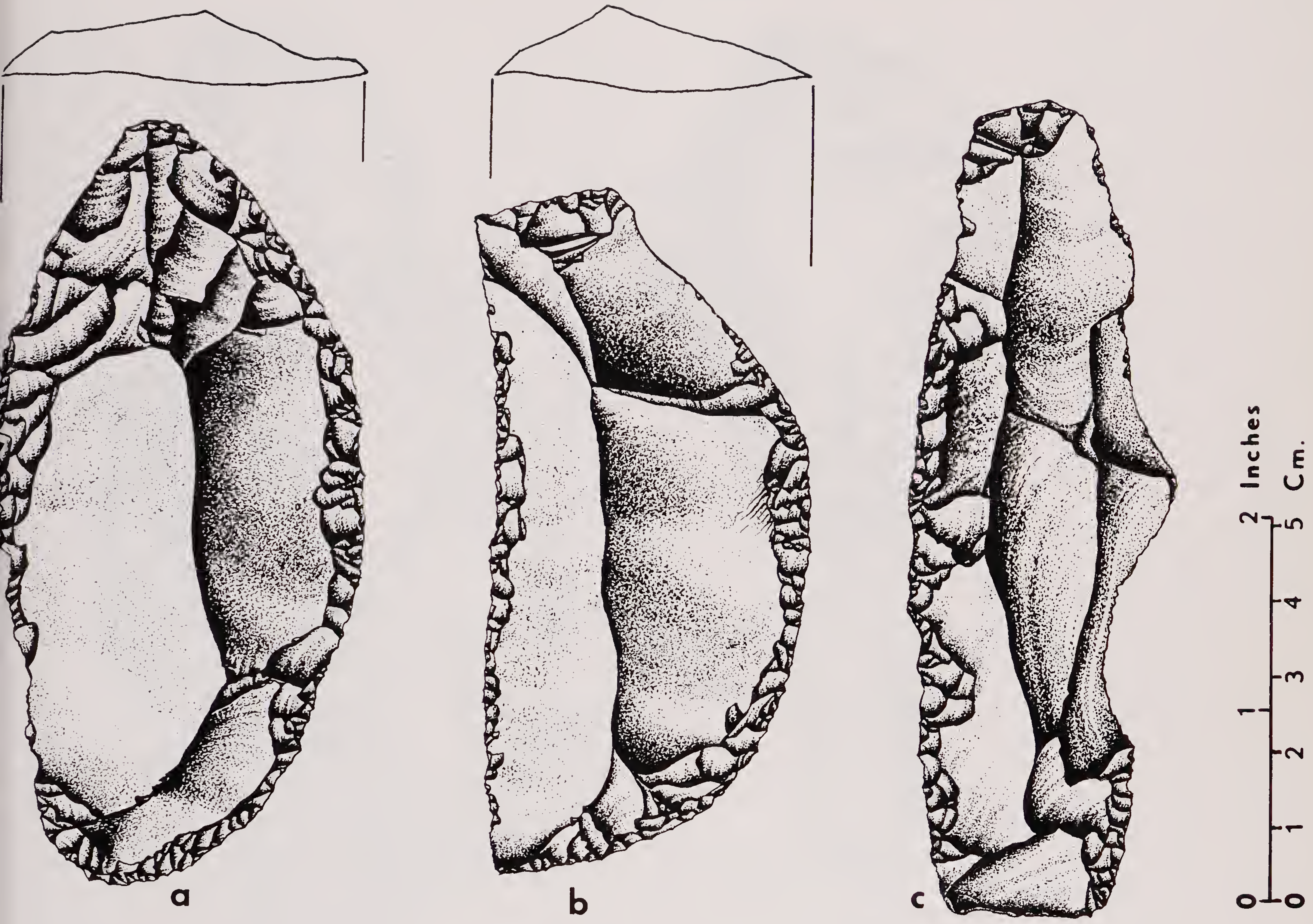


FIGURE 4.13. Flake (a, b) and blade (c) tools from the Hanson site.

scraper point (Figure 4.7a). Still other specimens demonstrate rounded working edges (Figure 4.7f; Figure 4.8a). Some composite tools demonstrate, for example, an end scraper working edge with a graver opposite (Figure 4.9e–f); two with deliberate single notches on one side at the end of the scraping edges (Figure 4.8b, d); another with a small, delicately formed graver point slightly off the center of the working edge (Figure 4.10g–h). A very specialized scraper is one on the end of a long, narrow, relatively thick blade that is triangular in transverse cross-section (Figure 4.10m). There was a definite preference for the red Phosphoria chert in the manufacture of end scrapers. This was very likely because of its relatively superior quality.

Sharp-pointed borers with alternately beveled points (Figure 4.10a–b) and gravers (Figure 4.10c–d, e–f, i–j, k, l; Figure 4.11c) with slightly beaked points were common tools although there is no evidence as to definite function.

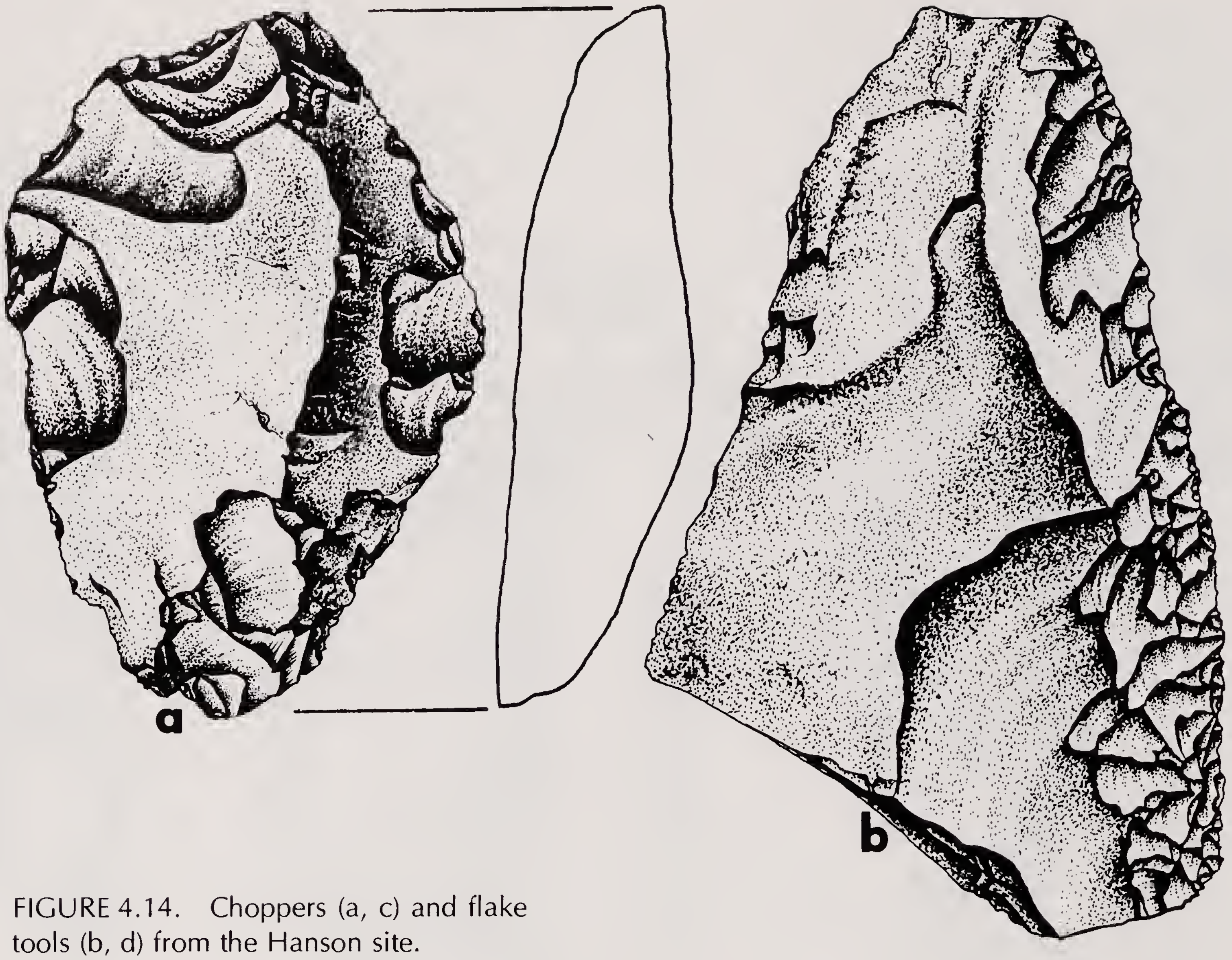
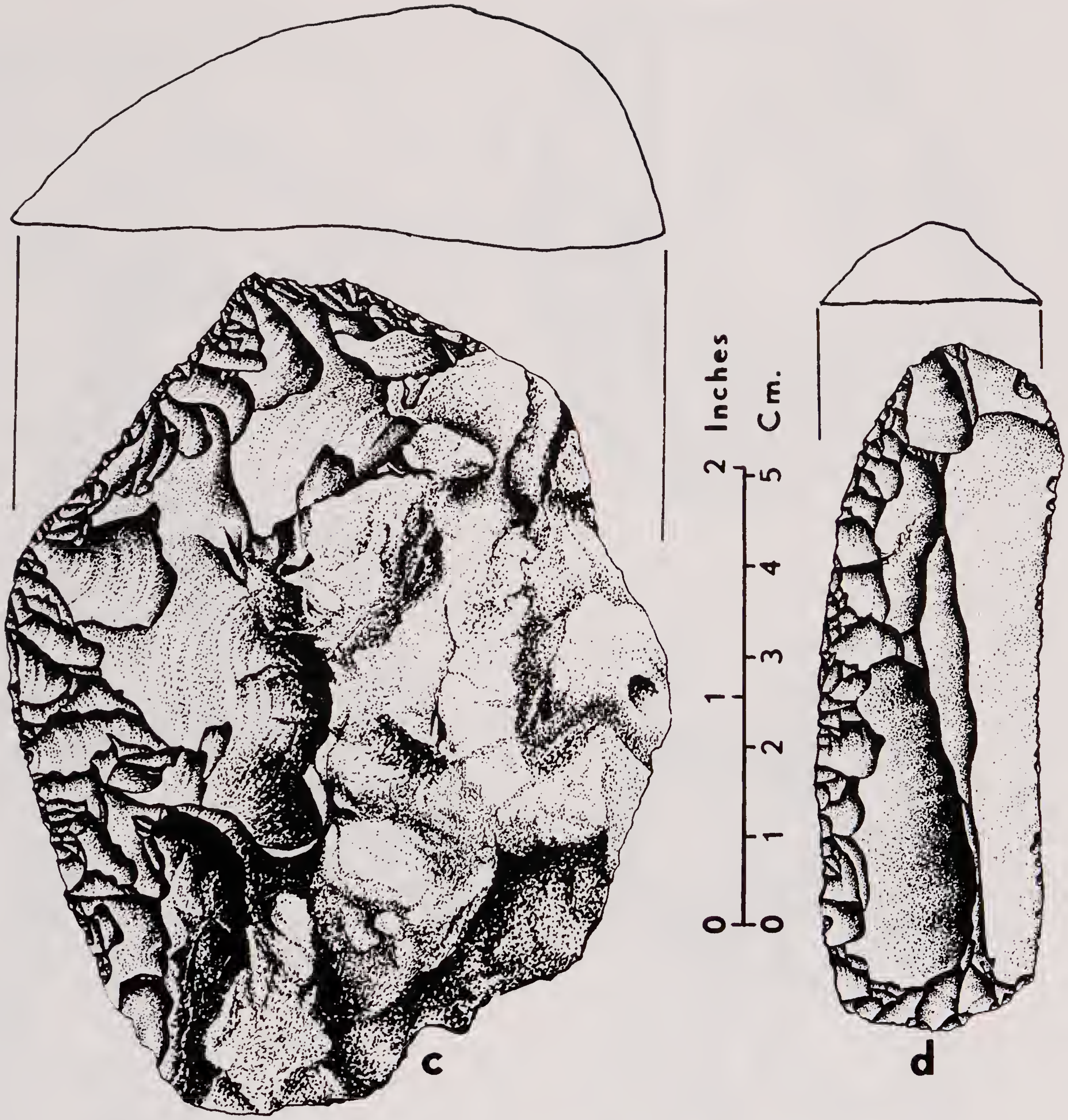


FIGURE 4.14. Choppers (a, c) and flake tools (b, d) from the Hanson site.

Graver points with lateral edges of the flakes demonstrating a fine, steep retouch on selected areas of the back sides are common (Figure 4.11a, d, e). Similar graving tools with multiple points of different shapes appear also (Figure 4.11f). The last two categories represent composite tools—one specimen has a graver point with a spokeshave edge adjacent, and other areas of the tool edge are modified to suggest a variety of possible uses (Figure 4.12a).

Artifacts that appear to be butchering tools, functionally identical to those in a number of bison kills spanning over 10,000 years, were recovered at the Hanson site. These are large percussion flakes, some with a lateral retouch on the back of the flake (Figure 4.12b, d; Figure 4.13a–c; Figure 4.14b, d; Figure 4.15c); a very few others demonstrate a lateral retouch on the bulbar side (Figure 4.12c). Both right- and left-handed tools were present.

One uniface tool is also functionally identical to those of a type common to bison kill and butchering sites of the Archaic and Late Prehistoric periods. It is relatively thick (12.6 mm) in cross section with both lateral edges steeply beveled on the back (Figure 4.16d). Tools of this nature are especially useful where a combination of cutting and scraping is required in butchering animals the size of bison. The tools become progressively smaller as they are resharpened and finally break or are discarded.



Other retouched flake and blade tools are too numerous to describe fully, but performed a wide variety of cutting, scraping, and puncturing functions. Many flake tools appear to be broken but actually are not. Edges of flakes were apparently deliberately retouched and subsequently snapped at various angles to create sharp points at junctures of flaked edges. Many of these demonstrate microscopic evidence of various kinds of use. Many edges formed by deliberate or fortuitous snapping of flakes and hinge fracturing were commonly used, probably for scraping. A special case includes wide, thin flakes, hit toward the center with a sharp-pointed hammerstone or similar tool so that the flake broke with a number of fractures radiating out from the central point of impact. The resulting points on such tools often demonstrate graver use (Figure 4.11b), and sharp edges were used as scrapers. Other wide, thin flakes were laterally retouched with cutting edges on the back (Figure 4.15a) or face (Figure 4.15d–e). Backing of tools such as these was common also (Figure 4.15e). Many flakes

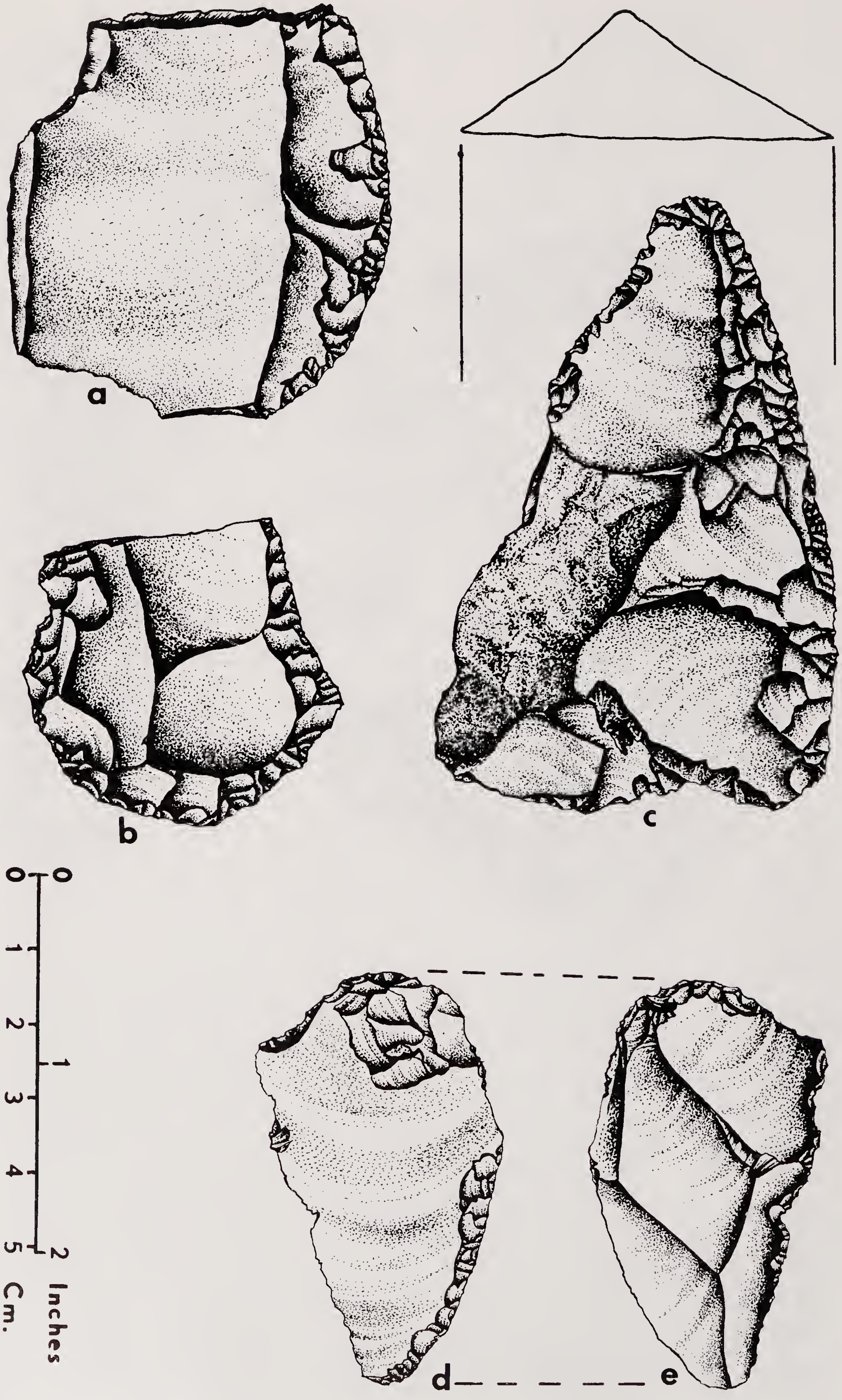


FIGURE 4.15. Flake tools from the Hanson site.

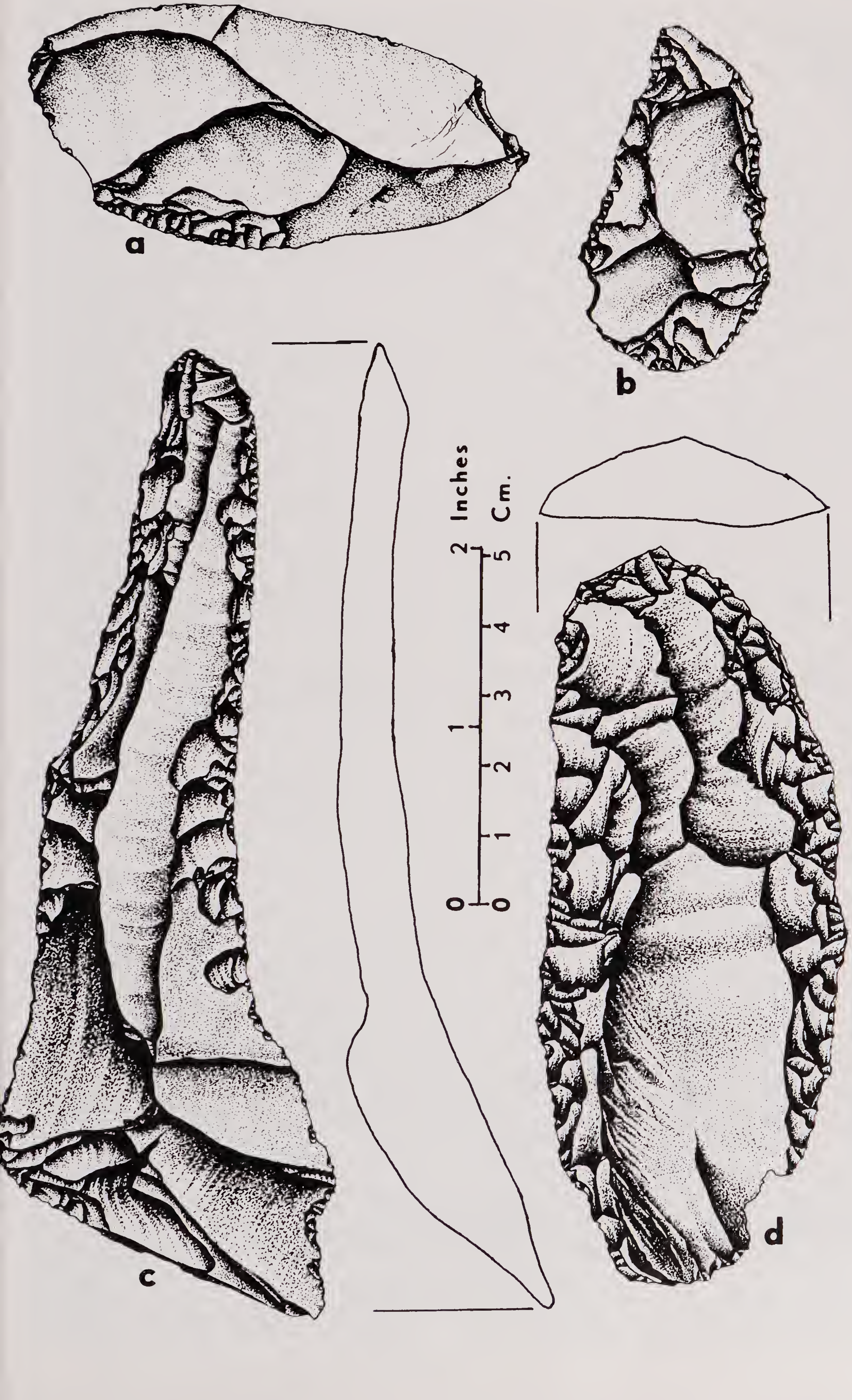


FIGURE 4.16. Flake (a, b), blade (c), and uniface (d) tools from the Hanson site.

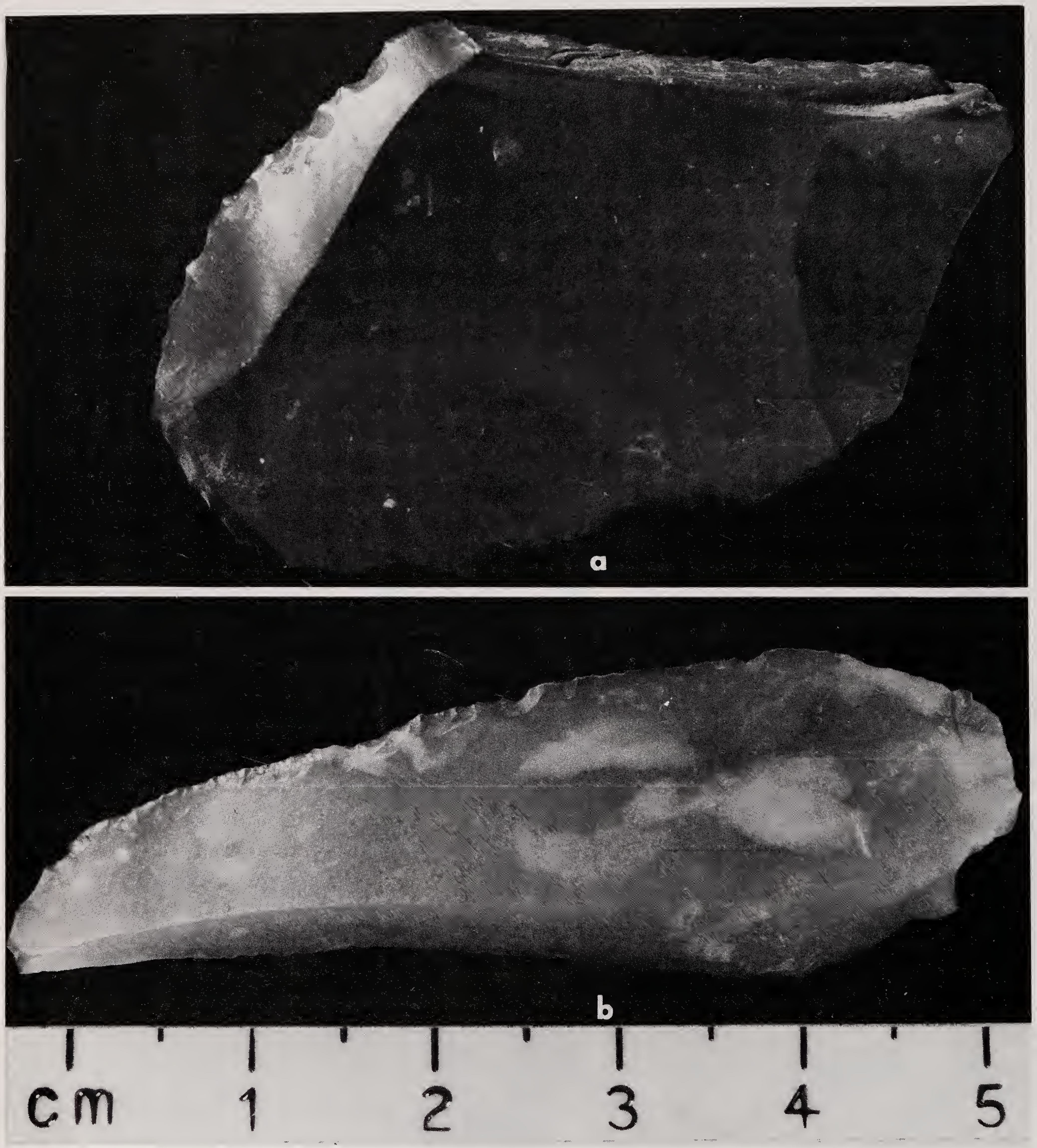


FIGURE 4.17. Flake (a) and blade (b) tools from the Hanson site.

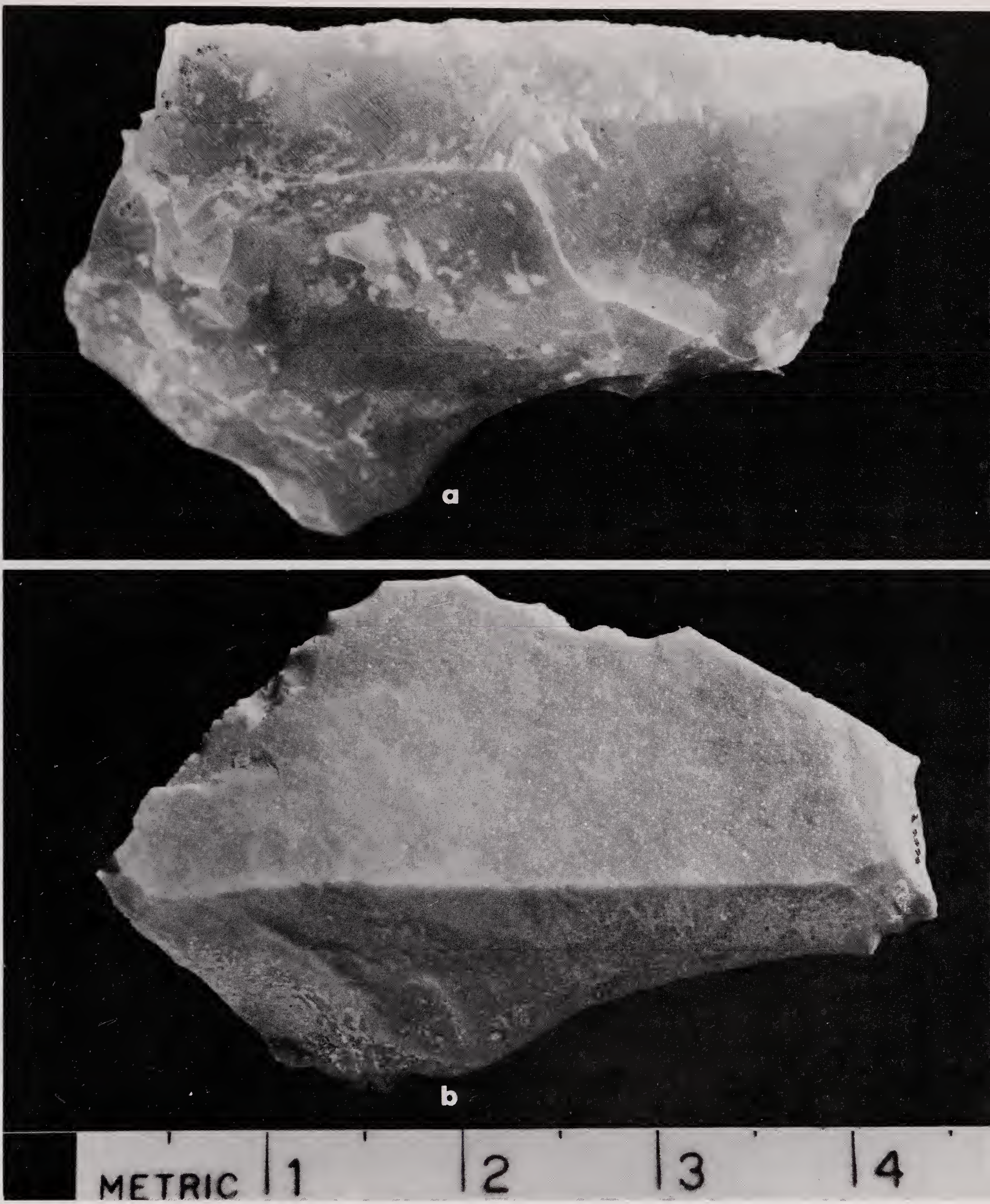


FIGURE 4.18. Flake tools from the Hanson site.

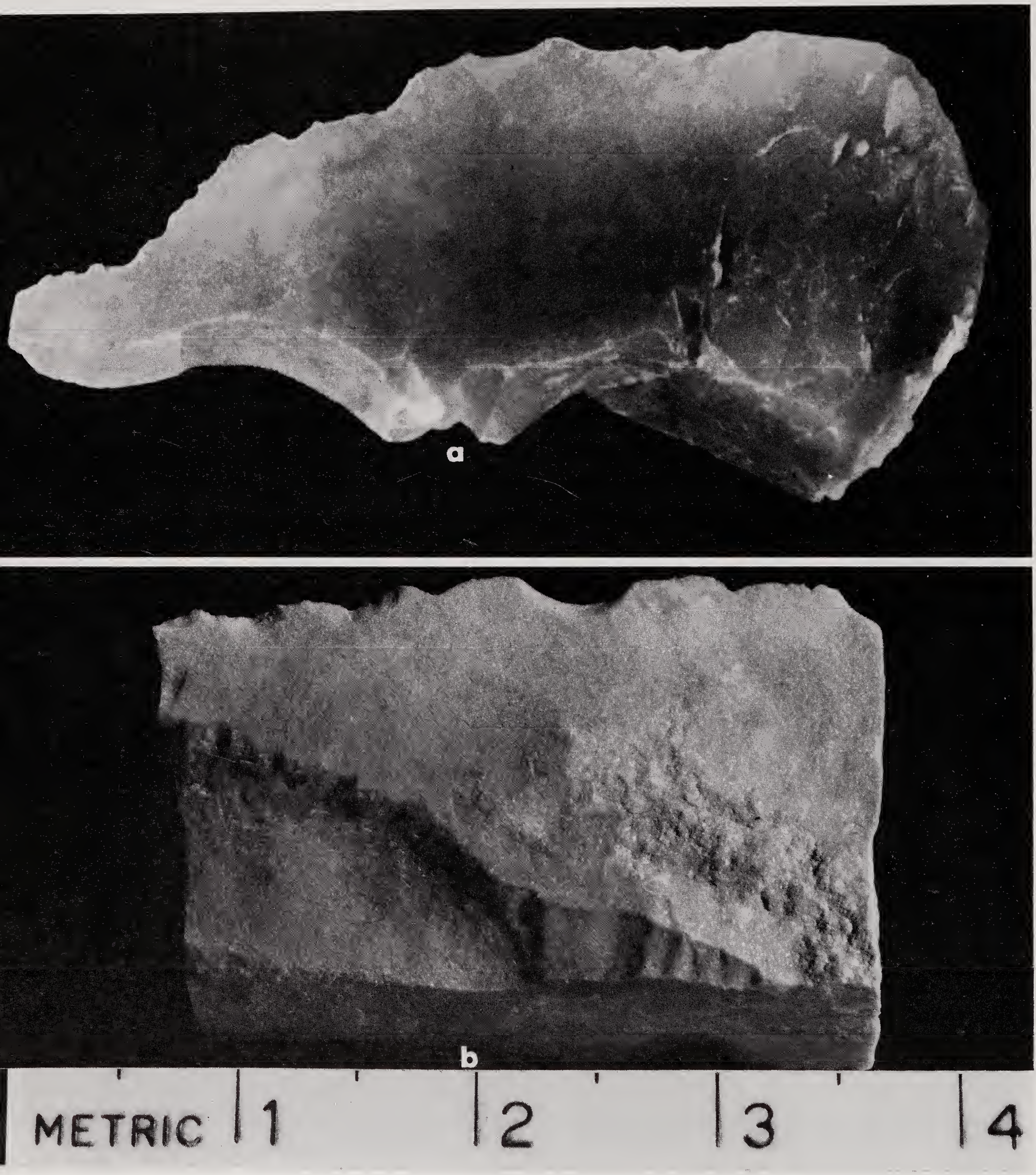


FIGURE 4.19. Flake tools from the Hanson site.

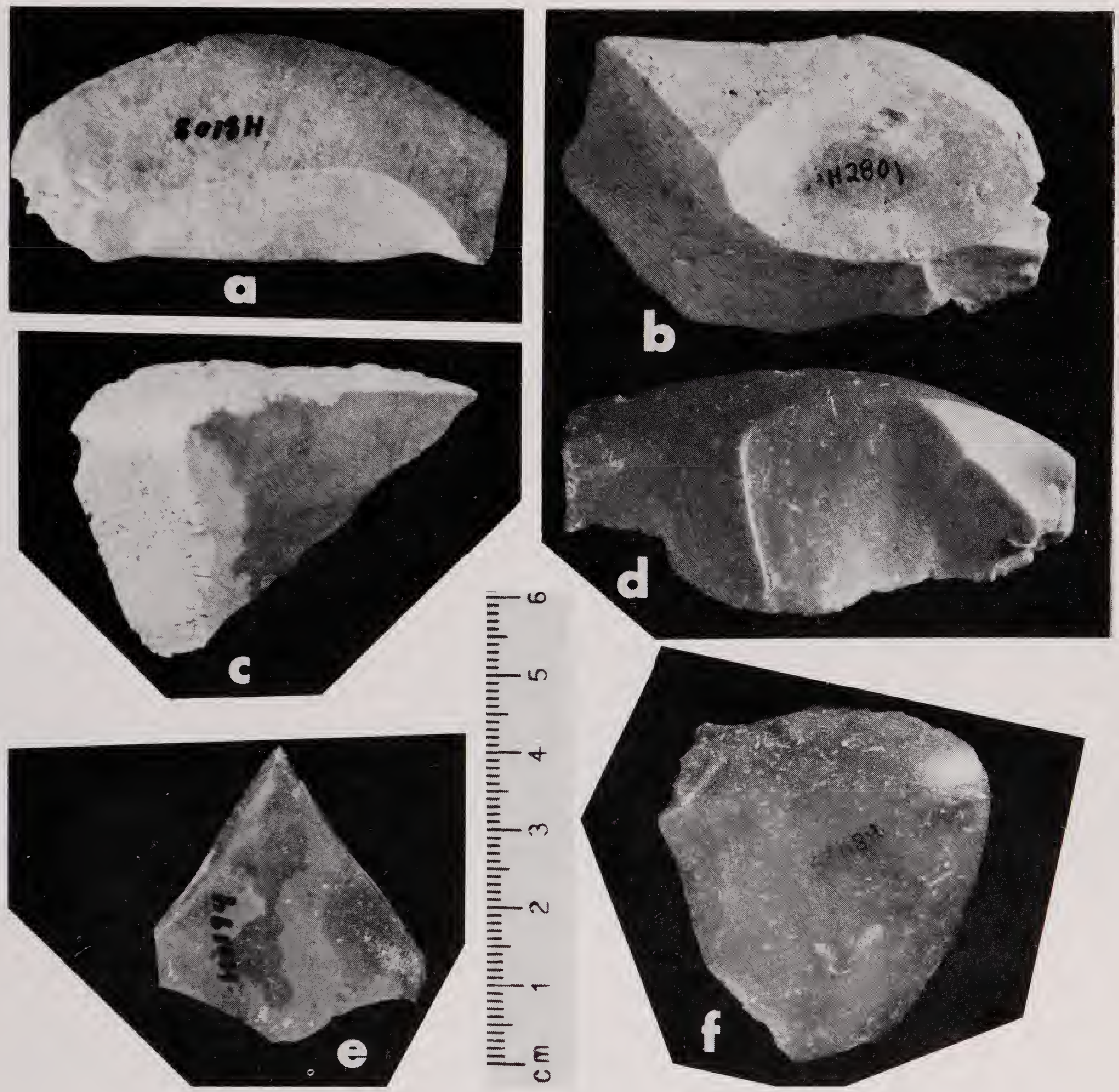


FIGURE 4.20. Flake tools made from gastroliths at the Hanson site.

demonstrate varying kinds of deliberate retouch laterally on backs (Figure 4.14d; Figure 4.15b; Figure 4.16a–c) and some of this was often for backing purposes as well as tool edge preparation.

Working edges of many flake and blade tools appear to be functionally adapted to specific tasks although the exact nature of these tasks is mostly conjectural. A backed flake (Figure 4.17a) and a blade tool with what appears to be a use retouch (Figure 4.17b) demonstrate both polish and fracturing of the working edges. The working edges on some flake tools demonstrate a carefully prepared, fine, denticulate edge (Figure 4.18a). On others the working edges are also deliberately prepared but denticulate edges are coarser (Figure 4.18b; Figure 4.19a, b). Other flake tools have working edges ground smooth at right angles or nearly so with the flake faces. Altogether these categories of flake tools encompass a wide continuum of working edges and also a wide range of task-specific tools.

Many flakes demonstrate along one or more edges almost microscopic retouch which apparently resulted from a combination of wear and flake removal through use. Thin, wide flakes in some cases demonstrate a fine retouch nearly perpendicular to the faces of the flake. This may have resulted from use, and an identical condition can be produced by scraping against wood or bone with a thin flake. Delicate end-scraper-like working edges are often found on properly shaped flakes; these edges usually appear to be from a deliberate pressure retouch (Figure 4.9g–h). Side scrapers often demonstrate both concave and convex working edges (Figure 4.9a–b, c–d). Another common cutting tool was made from core reduction flakes. The cortex was removed by driving off a continuous sequence of flakes from around the outside of a core. Many of the resulting flakes had the cortex on one edge and a sharp, knifelike edge opposite. Resharpening was usually done by a lateral pressure retouch on the back side (Figure 4.12d) but occasionally on the bulbar side; the cortex edge formed a natural backing.

It appears that gastroliths, with their highly polished and extremely tough rinds, were used to provide a special functional class of flake tools. Striking platforms were prepared and flakes driven off in a variety of shapes. Tool edges were formed at junctures of the polished rind and the bulbar faces of the flakes. Some edges (Figure 4.20a, b) served for cutting purposes whereas others (Figure 4.16a; Figure 4.20d) were composite cutting and side scraper tools. Others (Figure 4.20c, f) were end scrapers; still others were gravers (Figure 4.20e).

Utilization of channel flakes as tools was minimal. All the channel flakes recovered to date at the Hanson site were broken or shattered to varying extents. Occasional fragments bear evidence of modification—usually for use as scraping tools. Such modification is commonly in the form of a use retouch. Channel flakes are identifiable by the carefully prepared striking platforms and the flake scars on the back perpendicular to the long axis of the flake. As mentioned, false channel flakes can be produced by the buckling of a preform in an unsuccessful fluting attempt.

There was very little in the way of exotic stone flaking materials. Two blade tools (Figure 4.13c; Figure 4.16c) were made from a porcelainite that occurs in the Powder River Basin in northern Wyoming and southern Montana, a distance of about 100 miles east of the Hanson site. A single flake of obsidian occurred at the site and is an excellent, translucent type, possibly from Yellowstone Park—in particular Obsidian Cliff, which is 150 miles directly west of the site. We have not yet attempted neutron activation or other source studies to make an exact determination nor has the hydration rim been measured. The flake may not be amenable to dating since it has a burned appearance and was recovered from an area of a floor that was oxidized to a reddish color.

At least three choppers appear to be exhausted cores which were modified slightly. The working ends demonstrate a rather careless sharpening, achieved

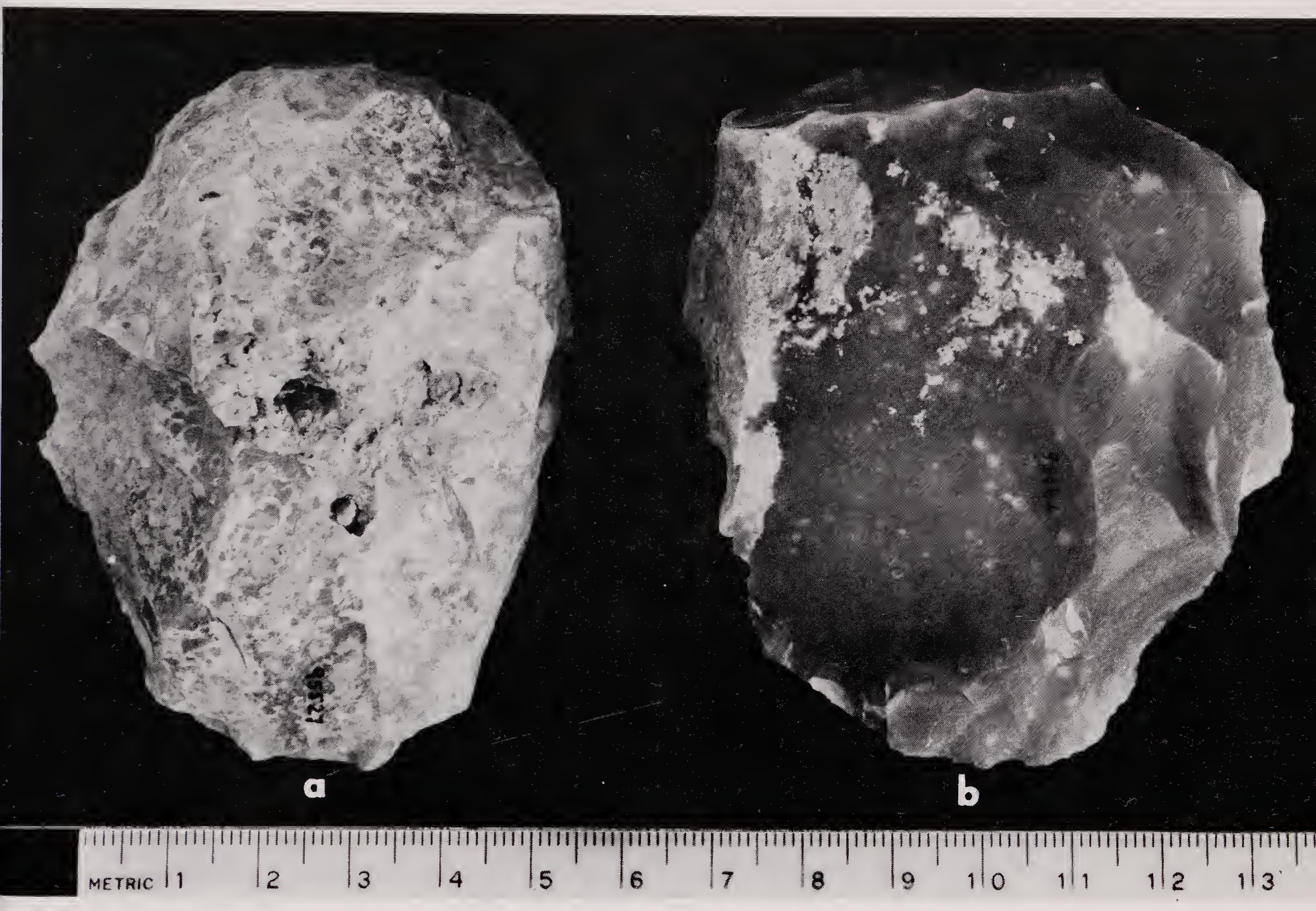


FIGURE 4.21. Stone choppers from the Hanson site.

by the driving off of a few flakes to form a sharp edge; opposite ends were left large enough to form a suitable handhold. One (Figure 4.21a) is 31.3 mm thick and another (Figure 4.21b) is 36.2 mm thick. Another chopper is a section from a large biface, consisting of the part from about center to one edge. Two others are chert nodules with sharpened edges and unmodified handholds. Two other choppers—or at least probable choppers—appear somewhat different. One, made from a large percussion flake, is triangular in outline form. One face is almost perfectly flat (Figure 4.22a) and the other face is steeply beveled on all three sides (Figure 4.22b). Its thickness is 12.6 mm. The convex edge opposite the bulb of percussion demonstrates evidence of continued resharpening. The second chopper was made on a split cobble, with the only modification being a carefully prepared working edge flaked from the cortex side. The thickness is 27 mm (Figure 4.14c). One chopper-like tool (Figure 4.14a) is much smaller.

Several hammerstone or composite hammerstone–chopper tools were manufactured from angular pieces of diorite and flat limestone slabs. A crude

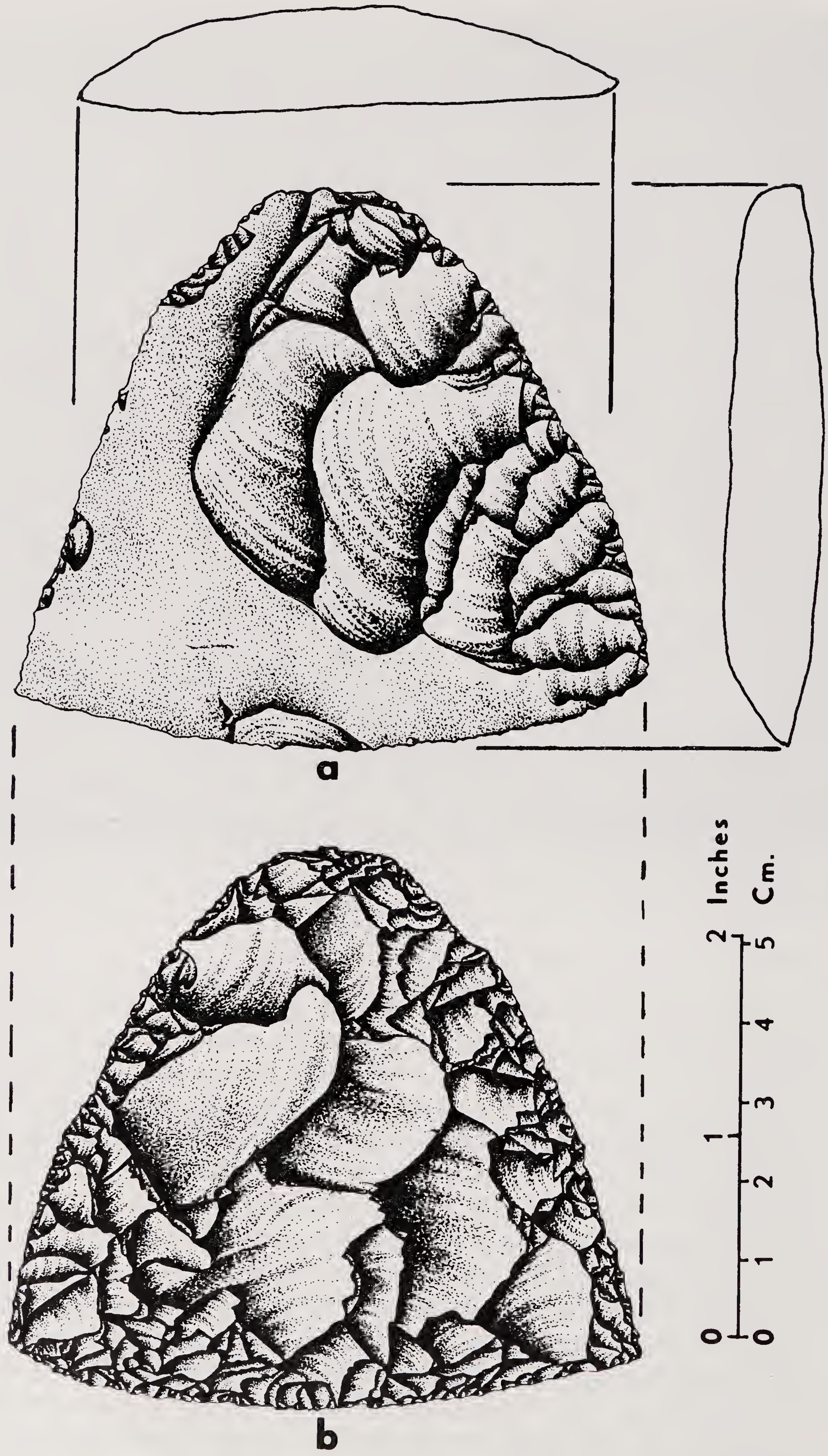


FIGURE 4.22. Biface tool from the Hanson site.

working edge was flaked, usually on a single side, and the resulting edges demonstrate pounding use. Their main use does not appear to have been as percussion flaking tools, although some use of this or similar nature is possible. Considerable shattering and breaking of bison bone was done at the site and the hammerstones may have been used for that purpose. Whatever the use, it was intensive and against something massive enough to drive off large flakes of the hammerstone material occasionally. Similar destruction of working edges can be duplicated by placing bison long bones on an anvil stone and crushing them. (The bison long bones at the Hanson site and other Folsom sites are somewhat larger and stronger structurally than the modern bison bones on which experiments with breakage were performed.)

Only a small sample of the Hanson site has been excavated and several hundred tools have been recognized. Many more tools yet remain to be recognized through careful microscope analysis. The more familiar Paleo-Indian tool types (see, for example, Irwin and Wormington 1970) are relatively easy to recognize and categorize but others are not. Improved functional analysis of the tool assemblage is needed before complete identification and more meaningful statements of the tool types and uses can be made. For these and other reasons, a cumulative graph of tool types would not be of much value until the site itself is better understood and the complete complement of tools is known, analyzed, and described. However, further investigations should provide the basis for a better understanding of Folsom tool types and uses. In this context, the entire tool complex rather than just the chipped stone specimens must be considered.

Bone tools are rare at the site. Bone is badly deteriorated as a result of soil conditions, and although some of the poorly preserved fragments of bison long bone may have been crude bone tools, the evidence of wear is no longer visible. A midsection of a small bone needle was recovered from a lodge floor. It is rectangular with rounded corners (1.25 × 1.52 mm) in cross section; whether it was an eyed needle is not known.

Red ocher appeared in quantity at all areas tested at the site. It occurred mainly as a red stain of varying intensity but occasional chunks were recovered. One piece 19.7 mm long was found that was ground to a prismatic shape 7.4 mm in height. However, the grinding may have been for the purpose of reducing the red ocher to particulate matter rather than to form a definite shape on the piece being ground.

Faunal remains include bison, mountain sheep, deer, marmot, and cottontail rabbit. Parts of at least three bison were recovered. It is not improbable that the site was selected because its location was favorable for animal trapping although no actual evidence of a trap has been found. Butchered units of bison indicate the site must have been covered shortly after use. A distal tibia articulated with all the associated bones to the proximal metatarsal suggests that this unit was prepared by breaking the two bones mentioned. After it was discarded, it was not exposed long enough for it to become disarticulated. The same is true of another unit consisting of the distal radius and the proximal radius–ulna. Bison long bone and other postcranial fragments cover the excavated areas of the site suggesting intensive and complete utilization of bison products.

Very little in the way of bison butchering can be extracted from the Hanson site at this time since the quantity of bone is relatively small and very little of it is in good condition. The butchered units recovered so far and their treatment suggest more advanced processing stages than those observed at the Casper site which was a primary animal kill site of Paleo-Indian age (Frison 1974b). Little also can be said about the subspecies of bison present at the Hanson site. Measurements on certain bones suggest they were quite large. The distal end of a humerus and an olecranon, for example, is slightly larger than the largest one recovered at the Casper site (Frison 1974b). This supports the data from the original Folsom site bones, which indicate they were also slightly larger than those of bison several hundred years later. A bison mandible fragment with M_1, M_2, and M_3 intact is from an animal that was apparently between 2.5 and 2.9 years of age (based on tooth eruption). Unfortunately the occlusal surfaces of the teeth are badly deteriorated and cusp wear cannot be accurately determined. If this one specimen is representative of the bison population, which it may or may not be, the site could be a late fall or winter occupation. However, a larger population sample is obviously necessary for any valid observations on seasonality based on animal ages at the time of death.

A mountain sheep skull was recovered in the same stratigraphic level as the Folsom materials but on the edge of a site activity area. It was associated with the Folsom cultural materials at the Hanson site although other mountain sheep bones have not yet been recovered. Scattered Folsom lithics occurred to within a few centimeters of the skull. Part of a mule deer antler tine that had been pushed directly into a habitation floor was recovered. It bears no evidence of modification or use before or after it was broken from the rest of the antler. Whether it was part of a larger piece pushed into the floor and then broken or broken first could not be determined. A few scattered cottontail rabbit and marmot bones were recovered on habitation floors, which suggests they were being used as food. Other small, unidentifiable bone fragments suggest utilization of a wide number of large and small mammals as food.

We have no evidence as yet to indicate the use of any vegetable food products at the Hanson site. This may be the result of a lack of prepared fire pits or hearths, which ordinarily trap charred seeds and similar evidence. However, the present-day local flora does include a number of plants that we know were used ethnographically as food. Among these are seeds of Indian ricegrass (*Oryzopsis* sp.) and other grasses; stems, leaves, and seeds of the saltbush (*Atriplex* spp.); leaves and stems of arrowroot (*Balsamorhiza sagitatta*); seed of amaranthus (*Amaranthus* sp.) and limber pine (*Pinus flexilis*); seeds of flowers of yucca (*Yucca* sp.); bulbs of wild onion (*Allium* spp.) and sego lily (*Calochortus nuttallii*); roots of bitterroot (*Lewisia rediviva*); cottonwood inner bark (*Populus* spp.); box elder bark and sap (*Acer negundo*); cactus (*Opuntia polyacantha*); and fruit of chokecherry (*Prunus melanocarpa*) and buffalo berry

(*Shepherdia argentea*). None of these are available during winter months except for the seeds (other than limber pine), cactus, and tree bark. An exhaustive list of plant resources would include many other species.

SUMMARY AND CONCLUSIONS

In summary, the Hanson site has undergone only a preliminary investigation. From this we do know that it is a large site but we have not determined the exact site limits. The present evidence suggests a campsite but there is no explanation for this kind of site manifestation in this particular location. It does not appear to be the kind of location favorable for a camp, but it may have been close to some sort of specialized activity, perhaps an animal trap. The lithic assemblage suggests a wide range of what can be considered normal campsite activity. The bison bone assemblage argues for animals killed not too far from the site. I strongly believe that some sort of bison procurement feature may have been nearby. Certainly the terrain a few hundred yards directly north of the site offers the ideal conditions for a bison trap—or at least a location bison could have been funneled into during their normal daily and seasonal movements. I base this interpretation on the assumption that the terrain and the vegetation have not changed radically in the last 10,000 or so years. The immediate area is also a favorable year-round habitat for mule deer and mountain sheep.

The areas of hard-packed earth at the Hanson site are believed to represent some sort of living area covered over by some kind of structures. If the age of the bison represented by a single animal is at all representative of the age of the bison herd resident in the area at that time, the cultural group may have been living there during the late fall or early winter months and some sort of a shelter would have been required. No unequivocal evidence of postholes was found nor was there any indication as to the nature of structures if they were present. At least two, possibly three, superimposed hard-packed floors were present but no determination of the time period between occupations was possible. Evidence of past use of fire was present inside the areas of hard-packed earth but there were neither fire pits nor hearths limited to definite areas by stones or other means, although some fire-fractured stones were present.

Lithics comprise the big share of the material culture evidence and raw material sources are plentiful locally. Exotic stone material is scarce and consists of one obsidian flake and two blade tools of metamorphosed shale. The former is probably of Yellowstone National Park origin and the latter is probably from the Powder River Basin to the east. All stages of Folsom projectile point manufacture are represented. A wide range of simple but functional tools was recovered. The Folsom culture as represented at the Hanson site was apparently nothing more than a group of Plains Paleo-Indian hunters and gatherers who possessed a high-level stone-flaking technology expressed mostly through a very distinctive projectile point manufacturing technique.

Whether this projectile point design was functional or aesthetic is not clearly understood; it could have been both. The remainder of the flaked stone technology is in no way as spectacular as that expressed in projectile points.

The evidence from the Adair–Steadman site (Tunnell 1975), the Hanson site artifacts and debitage, and my personal observation of the Lindenmeier site artifacts and debitage leave little doubt that the fluting process on Folsom projectile point preforms was accompanied by a high incidence of failure. There were also many degrees of success; it was apparently not unusual to discard a fluted preform that appeared to have all the qualities needed for it to be made into a functional projectile point but apparently lacked the proper flutes observed on completed specimens. What seem to us minor flaws in manufacture rendered a preform unsuitable for completion. On the other hand, some completed specimens bear no evidence of fluting.

Unpredictable and uncontrollable situations generally bring on a reliance on supernatural controls (see, for example, Aberle 1966). It is not at all difficult to picture supernatural activity being conducted during the fluting of Folsom projectile points. There is substantial evidence in prehistoric Plains cultures for hunting magic and shamanistic activities during bison pounding and jumping and antelope trapping. These situations are all economically oriented but projectile point manufacture was indirectly related to an economic process. I suggest that although fluting of Folsom points may have produced an ideal situation for hafting a stone projectile point to a wooden foreshaft, the fluting process operated at a level other than pure functionality. It represented a human drive for excellence in technological achievement. A certain amount of ritual must have ben involved in the fluting process in order to bolster the chances of success in a process that had a high incidence of failure.

5

Prehistoric Bison Hunting on the Northwestern Plains

We can document the fact that man has hunted bison on the Northwestern Plains for over 11,000 years, although it is quite possible that bison were being hunted before then. The earliest secure evidence we have attests to bison hunting during Clovis times by groups who also hunted mammoths. Much of the biological history of the bison during and since Clovis times is still conjectural, but we are certain that they were considerably larger then and since then have gradually diminished in size. The assumption that Clovis-period bison were larger is based on measurements of postcranial material from the Union Pacific Mammoth site in Wyoming (McGrew 1961) and the Murray Springs site in Arizona (Haynes 1970). The Colby site in Wyoming has produced only a few foot bones from an immature bison of unknown sex and these are not the kind of comparative materials needed for reliable body size determinations.

It should be established at this time that only arbitrary divisions can be recognized on a scale between communal, small group, and individual prehistoric bison procurement. Many archeological manifestations of bison hunting can be interpreted as being somewhere on a gradient between the two extremes. A single person would have employed all the skills of the hunter to get close enough to an animal to inflict a lethal wound. Two persons could cooperate, one manipulating an animal into coming close enough so that the other could get a lethal shot. Three people could encircle an animal or animals so that someone would be almost certain to get at least one lethal shot and possibly more than one. More than three hunters might manipulate a few animals into a small arroyo trap or similar feature where the hunters had an even better chance of getting one or perhaps several animals. The hunters in a social unit such as a small band could number a dozen or more; by cooperating under favorable conditions they could carry out a sophisticated trapping operation and obtain several animals. The trapping operation could have been repeated several times until food requirements were met or until adverse conditions (such as bad weather or migration of the animals to other areas) made further efforts impossible. When the latter happened it was best for the social unit to fragment again, since the conditions were then more favorable for single or small group hunting.

Jumping of bison could have come about easily and accidentally. Wild animals and even domestic animals may, if crowded together near a precipice, and frightened (especially by humans), crowd one or more of their number over the edge. If a large number of animals are stampeded in rough terrain, the possibility of crippling or killing one or more is increased, but the dead animal or animals may be in a spot too inaccessible for retrieval. It is better to allow the animals to reach more favorable terrain before they are killed. It is easy to conceive that systematic buffalo jumping emerged out of accidental or unsystematic buffalo stampeding in rough terrain. The same can be argued for bison trapping. Animals found grazing in the bottom of a steep-sided arroyo could have been accidentally stampeded into a situation where the only escape was back the way they came. Any human with hunting instincts would have realized the potential value in terms of animal procurement.

Perhaps the terms *butchering* and *processing* need to be clarified. In terms of twentieth-century culture, butchering includes those activities that occur after the animal is killed and before it is ready to be cut up for consumption. In a modern slaughterhouse, this includes skinning, removing the internal organs, removing the feet and head, splitting or quartering the animal, and hanging it for aging. Processing includes subsequent operations of dividing various parts of the animal into the proper cuts.

The division in a prehistoric or primitive situation is not quite so clear-cut. Here butchering includes the activities that occur on the spot where the animal is killed. Much of the activity in the actual kill area in the prehistoric situation was, therefore, what in the present-day situation we would consider processing. Some parts of a large animal such as a bison were often completely stripped of flesh before other parts of the carcass were even skinned. Processing in this context includes activities that occurred in a separate area, away from the kill area (although in some cases the entire operation took place at the kill area). This includes cutting meat into thin strips for drying, breaking long bones for marrow, and boiling bone grease and other food products from both kill and processing area where the hunting group camped. Depending upon many factors, there were many variations in the activities that occurred in both kill and processing areas. In essence, the basic concept of the utilization of large animals for food by human groups requires an initial butchering of the animals to prevent spoilage and to reduce the animal to its various components for ease in handling, and then the removal of the various parts to another area for further preparation and final consumption. Remember also, however, that consumption of certain parts of the animals (the liver for example) may have begun as soon as the animal was killed according to reliable ethnographic evidence.

THE PALEO-INDIAN PERIOD

The best evidence for a systematic bison kill during the Clovis period comes from the Murray Springs site (Haynes 1969; Hemmings 1969). I have analyzed the mandibles of several younger animals from the site to determine age at time of death. Three were estimated to have been about 2.7–2.8 years of age; two others, about 4.8 and 5.8 years. Another had reached maturity, but without an adequate sample of animals in the older age groups, I could not establish a reliable age for this single older animal. However, the age structure of the immature animals strongly suggests a single-event kill. If the calving season was the same then as it is now, the kill probably occurred in December or January.

Bison hunting during the Folsom period suggests some hunting sophistication. The Folsom site itself (Figgins 1927) strongly suggests a single event or at least events that took place over a short period. A sample of 12 ageable mandibles from the site fall into 4 age groups a year apart. The time of year was apparently early winter or midwinter provided the calving period was comparable to the present. The possibility of an arroyo trap and a communal kill at the Folsom site should definitely be considered. The evidence at Bonfire Shelter (Dibble and Lorrain 1968) leads me to believe that buffalo jumping was taking place at this surprisingly early time.

For the post-Folsom period the evidence for systematic bison procurement increases. We have reliable data on the actual methods of bison procurement from several sites. The Agate Basin site (Bass 1970; Roberts 1943, 1951) is one example. This site was first recognized during the mid-1930s as one of importance by my uncle, Robert Frison, then of Newcastle, Wyoming. After finding projectile points of unusually fine workmanship eroding out of an arroyo bank along with bison bone, he brought the site to the attention of Frank H. H. Roberts of the Smithsonian Institution. Excavations were made but little in the way of definitive or interpretive publications resulted (Roberts 1951, 1961). Further excavations were carried out at the site during the summer of 1962 but these yielded little if anything in the way of evidence for actual bison procurement at the site (Bass 1970).

Several years of surface survey and careful testing revealed that there was a good deal of information left at the site. In 1975 the decision was made by myself to reinvestigate. The main problems proposed were to determine the time of year the bison were killed, the kind of topographic feature the animals were killed in, the butchering and processing methods involved, and something of the population structure and morphology of the bison in the site.

So far results have been quite successful. Unfortunately a continual attrition of the site has occurred through the years through unauthorized digging. However, a large part of the site remained intact. A significant part of a bone bed remained providing a good sample of measurable bison skeletal elements along with cultural materials. In the next section I shall discuss the Agate Basin site in detail. The reader must keep in mind that the site area contains more than a single Paleo-Indian cultural component. Agogino (1972) described a Folsom component from the immediate area and Hell Gap projectile points have appeared also. There are a number of tested places that are slated for future investigation. At this time the cultural affiliations for these are not known except that they are Paleo-Indian from their stratigraphic position. A good deal of the interpretation of the Agate Basin site will rely strongly on geological studies.

The Agate Basin Site

The Agate Basin site is located in extreme eastern Wyoming on a usually dry tributary of the Cheyenne River, close to the southern end of the South Dakota Black Hills. The Cheyenne River begins further west and drains a large area of rolling Plains but carries significant amounts of water only during rains and spring runoff. It is an area of typical short grass plains. The Cheyenne River flows around the southern end of the Black Hills and the arroyos flowing into it form areas of "breaks" or rough terrain. The Agate Basin site lies in such an area. A long stretch of country with low relief is suddenly interrupted by an area dissected with deep, narrow arroyos (Figure 5.1). Within the memory of many local residents a spring at the site location was a source of domestic water. At present the spring does not run but a dam across the arroyo backs up water the year round. Although a number of reservoirs and wells have been constructed for both livestock and domestic use, the area is poorly watered.

The arroyo at the Agate Basin site is about 10 feet or so in depth but rapidly becomes deeper further downstream as it gathers runoff from other tributaries. The bottom of the arroyo is grassed over. Occasional knickpoints (Schumm and Hadley 1957) or box-canyon-like features that result from headward erosion in ephemeral streams are encountered. It was probably such a feature that served as the trap at the Agate Basin site. A number of features that would serve as ideal bison traps (Figure 5.2) can be found in the immediate area today. I suggest here that the bison at the Agate Basin site were killed in a geomorphic feature similar to that shown in Figure 5.2.

The most likely method of bison procurement at the Agate Basin site would have been to maneuver animal groups of possibly 10 to 20 animals into the arroyo bottom at least several hundred years below the trap. The actual spot would have depended upon the topography at the time. Once in the arroyo bottom, the animals would have been driven upstream until the knickpoint barrier was reached. Hunters would have been stationed at critical spots, such as tributary arroyos or places where the banks were not steep enough to contain the animals. When the lead animal or animals reached the barrier and attempted to turn around, enough confusion would have been created so that the animals could have been killed. It is possible that a barrier of hides was dropped behind them. The animals had to be kept moving steadily up the bottom of the arroyo. This required close pursuit by the hunters, because the

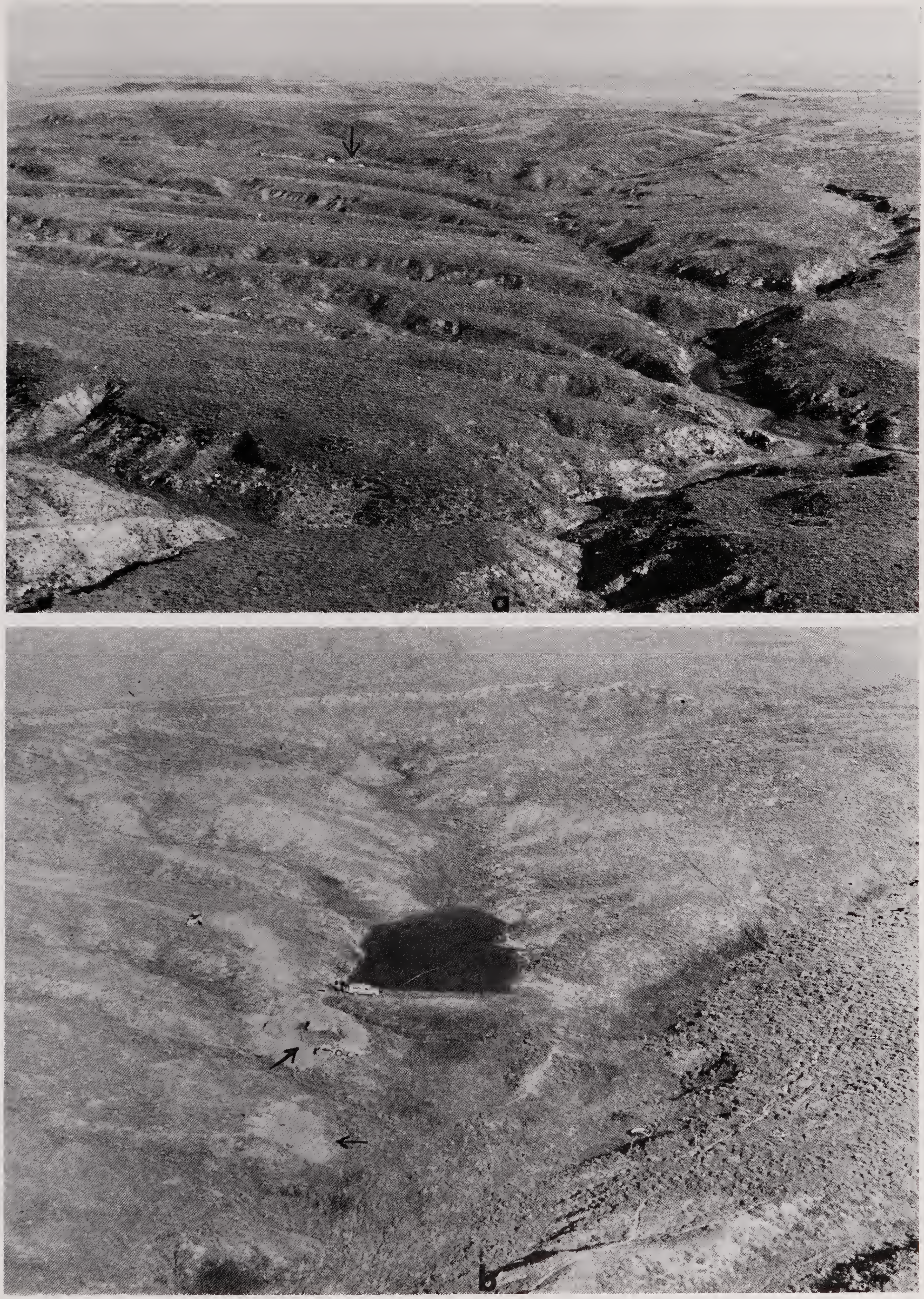


FIGURE 5.1. Aerial views of the Agate Basin site.

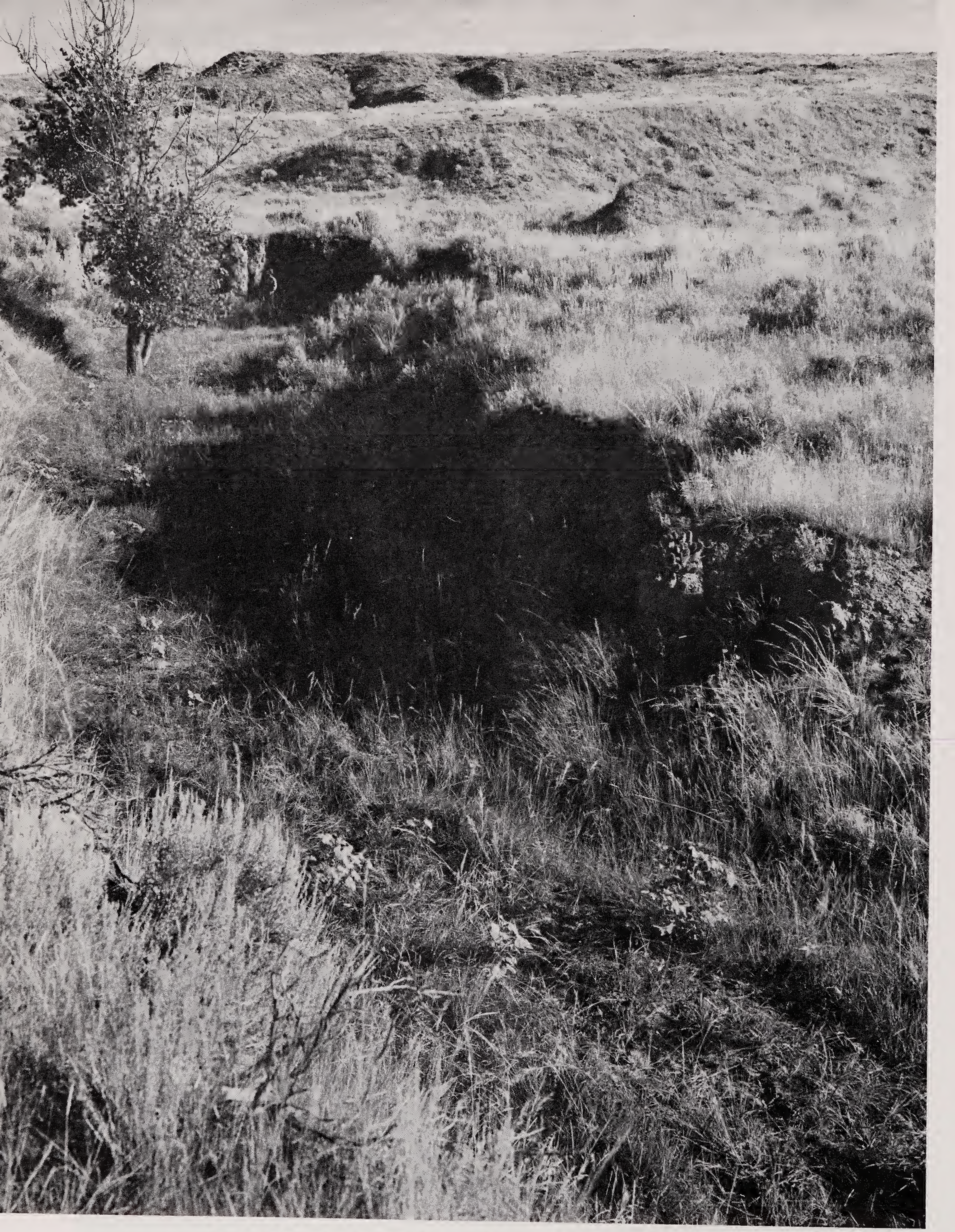


FIGURE 5.2. Analog of prehistoric bison trap close to the Agate Basin site.

bison would turn and head in the opposite direction if they were not pursued closely. Once turned they would have been impossible to stop and the entire venture would have had to be initiated from the beginning.

The actual method of killing is conjectural. Large numbers of projectile points found in the kill area bear evidence of heavy impact and breakage and leave little doubt that they were used to spear the animals. Whether they were used in thrusting spears or with a throwing stick is not known. In a trap there is a strong argument for the use of a thrusting spear, especially if the hunters actually went into the trap to kill the animals. First, a spear is the ideal weapon in a confrontation situation. The wild animal that realizes it is trapped usually goes quite berserk for a time. An animal in an arroyo trap would probably try to jump out over the arroyo bank or charge through the herd. At this point the animal is extremely vulnerable to either thrusting spear or atlatl and dart. The animal may also charge the hunter, in which case it is extremely vulnerable especially to a spear thrust. After the spear thrust, the hunter has the spear shaft, which affords a lot of protection from a charging bison. The herds at this kill site were probably composed mostly of several mature females with younger animals no older than 2 or 3 years of age, probably the females' own offspring. There were small numbers of mature males also present. The real threat to the hunters in terms of charging animals would have been the older females and mature males. Once they were dispatched, the remainder would not have presented as much of a danger, and the younger animals would not have tried as hard to escape. The calves and even yearlings would probably have remained at the sides of their dead mothers.

There would have been a danger, however, of the animals escaping. Unless there was a solid gate at the entrance to the trap, a berserk animal could force its way through or be crowded through by other berserk animals. Normally the animals would not force their way through unless a hole was present that gave them a view of open country beyond.

An early interpretation of the Agate Basin site was that it was a bog into which the animals were driven. Evidence for this was part of a bison skeleton with the rear legs intruded well into the deposits on the floor of the kill area, an observation made by Robert Frison, the first investigator at the site. Judging from a verbal description given to me I am quite certain that the rear feet of this same animal were found *in situ* during the 1975 site investigations. The two feet were in articulated position (Figure 5.3). The metatarsal was complete on one but only the distal metatarsal remained on the other. However, it was a fresh break, indicating that the remainder of the bone had been removed during the first excavation at the site. The position of the phalanges indeed suggested that they had been forced into the soil deposits in the bottom of the arroyo. However, they were intruded at a low angle and, although the soil may have been wet at the time, the deposits do not appear to have been bog deposits. The position of the two rear legs suggests that the animal was exerting considerable effort in a muddy area, but it does not suggest that the animal was bogged down.

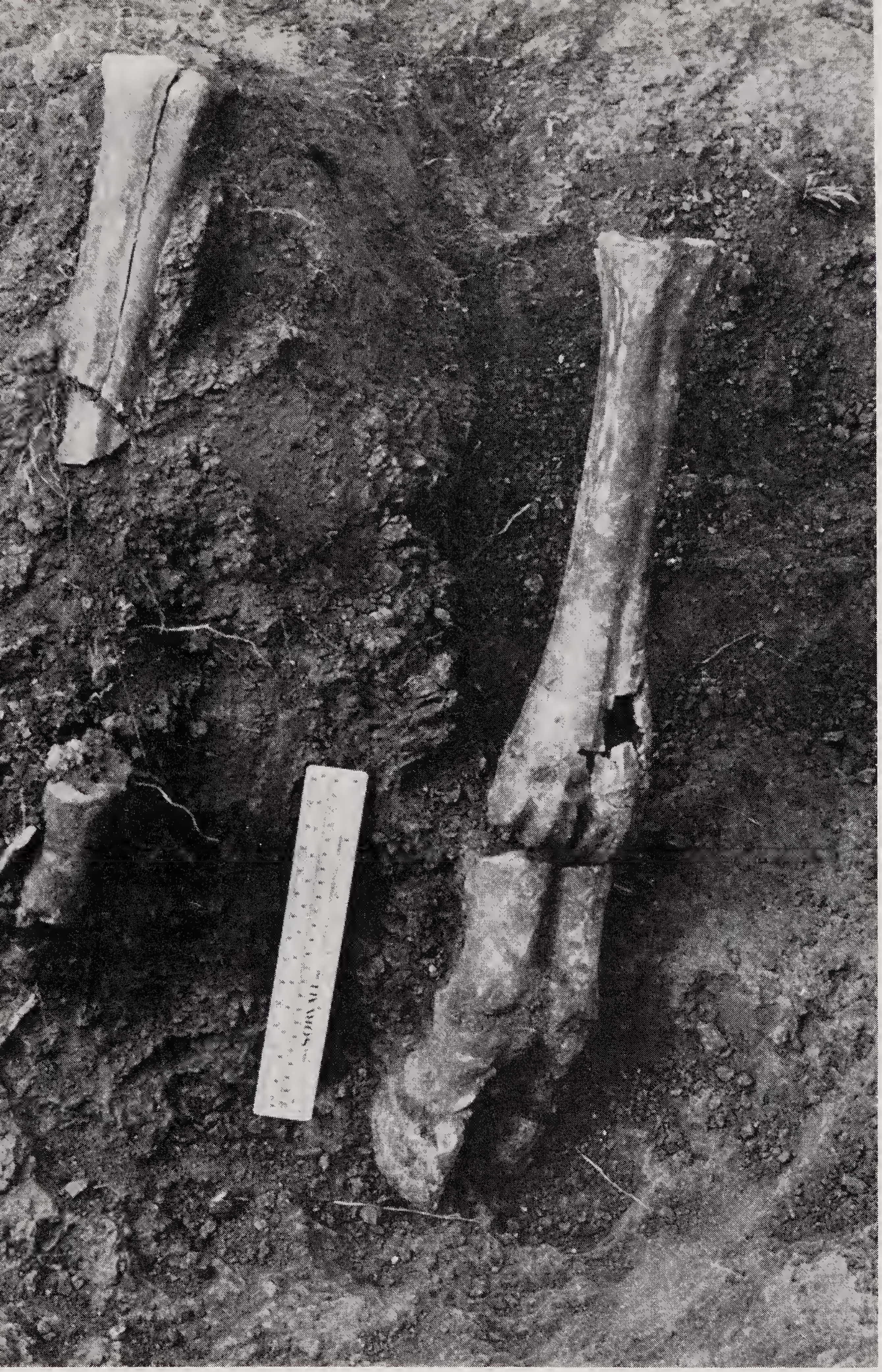


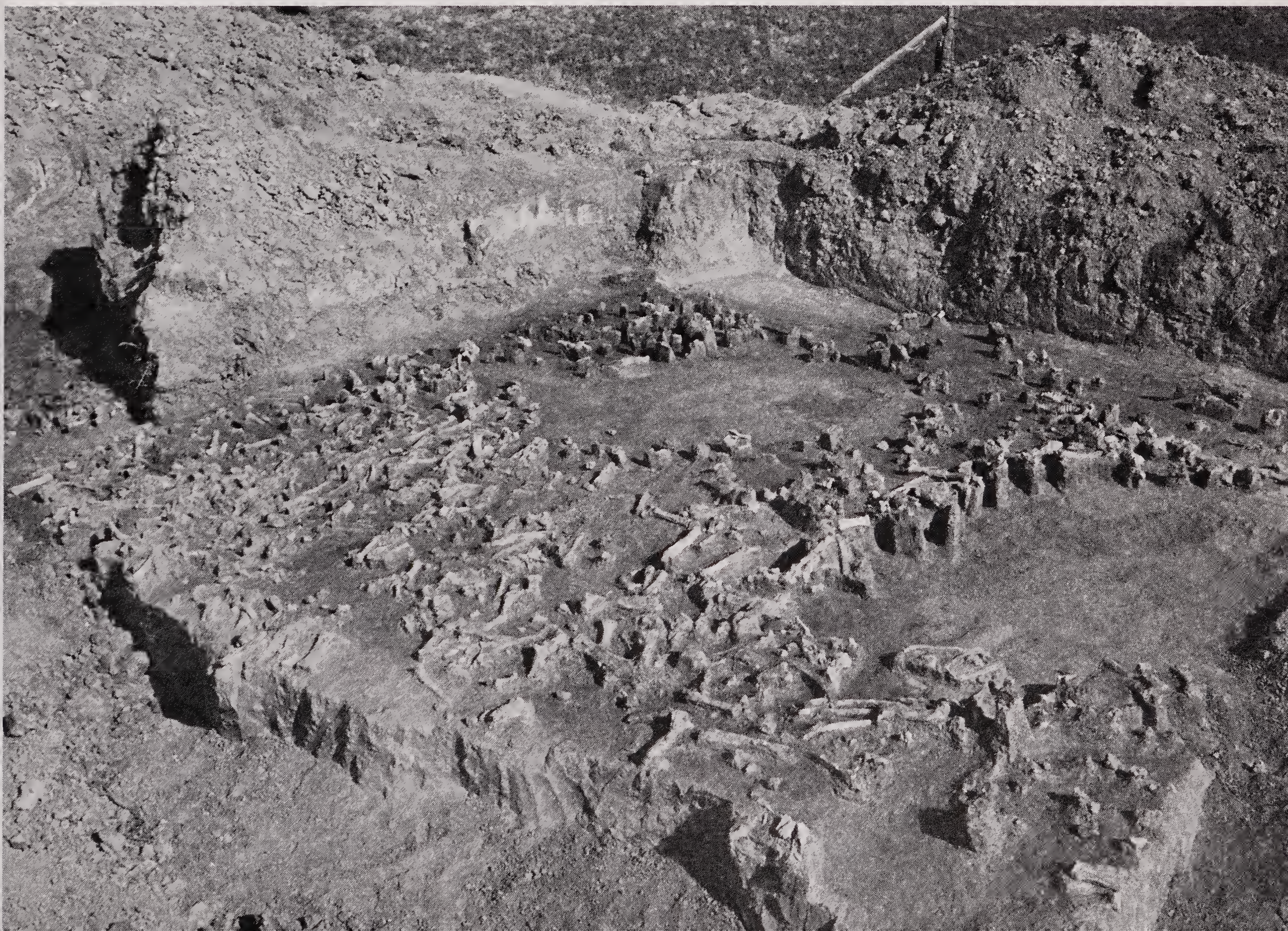
FIGURE 5.3. Rear feet of bison *in situ* at the Agate Basin site.

A bone sample was recovered in the kill area, but most of the bones were not *in situ*. Even so, it is regarded as the remains from a single bison population and tooth eruption analysis of the mandibles indicates that the animals fall in yearly age groups. None of the artifact material recovered is typologically other than Agate Basin. In addition, some bone and artifacts were recovered *in situ* and the latter are all Agate Basin. There is no evidence of more than a single cultural level at this part of the site. The original Agate Basin site was apparently a bone bed lying at the bottom of an old arroyo that was about 2 m above the bottom of the present arroyo. It is believed to have been a kill area because of large numbers of complete long bones and elements of axial skeletons. Most of these had been disarticulated and broken before the 1975 investigation but still constitute a valuable study collection.

Subsequent to the bison kill, the site was covered with nearly 2 m of alluvium in places. Later downcutting and lateral movement of the arroyo destroyed part of the kill area; we may never know how much. However, judging from the width and depth of the present arroyo, only a small part of the site was left.

Remnants of a butchering–processing area are located up the arroyo a short distance from the kill area (Figure 5.4). It is interpreted as such because of the bone distribution, the treatment given bones, and the artifact material present. Projectile points recovered here are without exception of the Agate Basin type, although two and possibly three separate cultural levels are represented. However, there is only one actual bone bed and the other levels are manifest by a small amount of bone scrap, a few small chipped stone tools, and a small amount of debitage. In the main bone level, several chipped stone tools were recovered and these all suggest butchering and processing. There were no large articulated butchering units, which suggests almost complete disarticulation of the animals, indicating a high degree of animal utilization. Placement of the

FIGURE 5.4. Bone bed at the Agate Basin site.



bones does suggest, however, that nothing in the butchering–processing area was disturbed subsequent to original placement and that the area was covered by alluvium shortly afterward. The deposits have been truncated by an arroyo, so the site's original dimensions may never be known.

It is strongly indicated that the butchering area was on the gentle slopes of the wide, flat arroyo bottom. This is reasonable to assume since there was very likely a thick covering of grass if present conditions are any indication of the past. Today the arroyo bottom produces a thick, heavy grass cover a foot or more high, and even under heavy grazing pressure it is not eaten off in the fall before it is covered too deep by winter snow to be available for livestock. When the snow melts in the spring, however, the grass cover is still there. Runoff in early spring is rarely enough to inundate the arroyo bottoms as it is later on in the spring and summer when heavy gully-washing rains occur. The gently sloping, grass-covered sides of the arroyo would have provided optimum conditions for butchering during the time of year the kill is believed to have taken place.

A number of bison mandibles were recovered from both kill and processing areas. Several of these were from immature animals, and fairly accurate age estimates for the time of death were made by measuring tooth eruption and wear. The animals fall into distinctive age groups. Calves were close to a year old (actually between .8 and .9 year). The next oldest were about 2 years old, the next, about 3 years, the next about 4 years and soon up to about 12 years. There are no animals between these ages. This means that the Agate Basin bison were probably killed within a month or so of calving time—probably in late February or early March.

No cranial material was recovered in the 1975 excavations so no comparisons can be made with crania from kills of comparable ages. One female bison cranium from the site was recovered several years ago during the Brewster site excavations (Agogino 1972) and this specimen has been described elsewhere (see Wilson 1974a:163, 165). A fair sample of metacarpals and metatarsals were recovered along with several astragali. Measurements on these suggest animals of about the same size or slightly larger than those from the Casper site (see Chapter 7, Tables 7.1–7.3).

However, in 1976 part of a young male bison skull was recovered (Figure 5.5). Unfortunately all teeth were missing and bone preservation was poor, but a comparison with present-day animals of known age suggests the Agate Basin specimen was about 2 years old. The horn core is quite massive and the distance from horn core tip to the midline of the skull is 47 mm. The skull was recovered at the edge of the butchering–processing area in a shallow depression.

Projectile Points from the Agate Basin Site

Fourteen complete and broken projectile points recovered by Robert Frison were located and the present owner, Robert Frison, Jr., contributed them to the site collections. One projectile point was recovered in a 5′ × 10′ stratigraphic test in 1972, 20 were found in 1975, and 23 were found in 1976. The

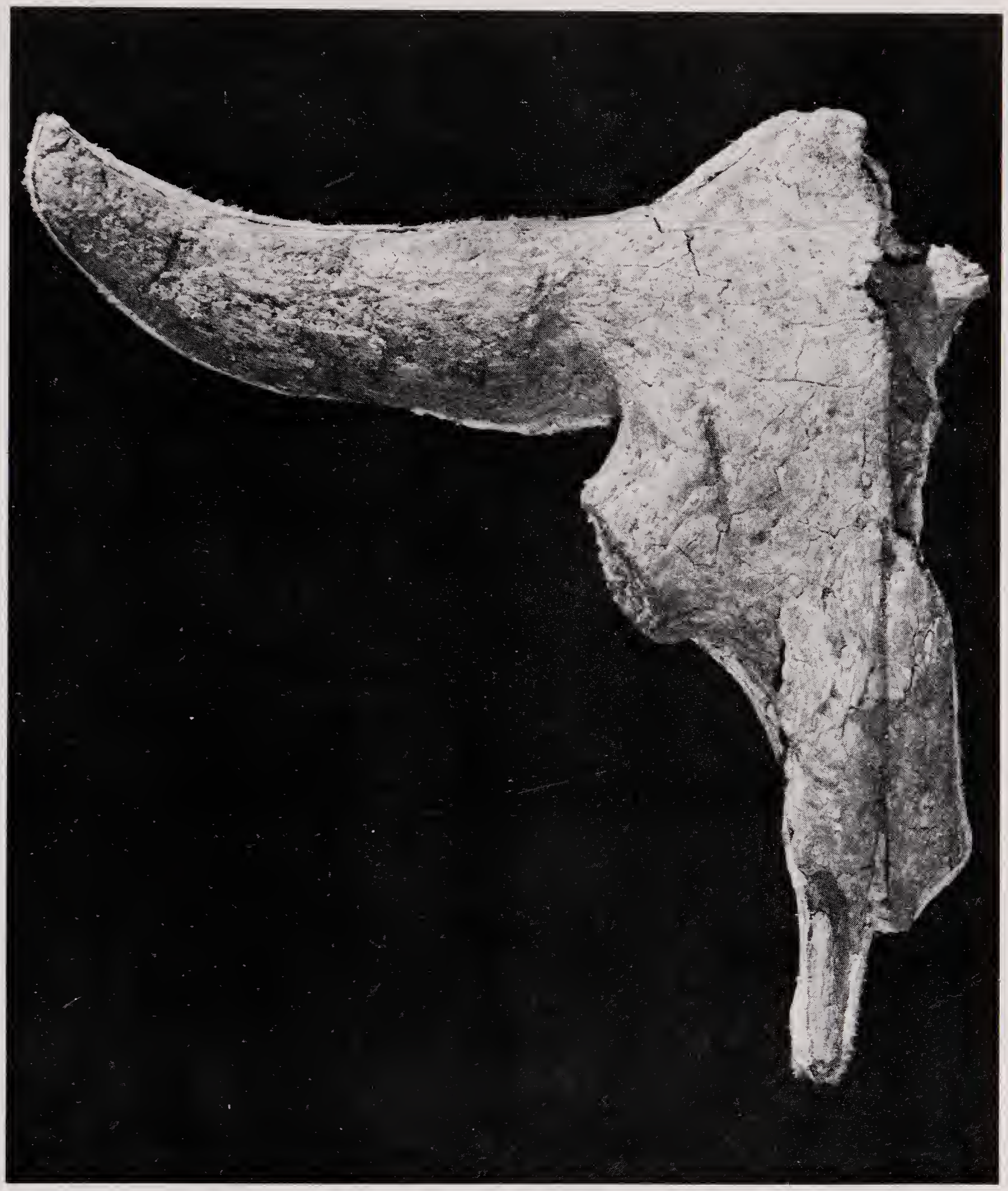


FIGURE 5.5. Male bison skull from the Agate Basin site.

sample is now large enough for me to make meaningful statements about manufacture, use, and general attributes. I plan in the near future to compile a complete site report, combining the recent data with that collected earlier by the Smithsonian investigators.

Nearly half the projectile points were made of what unquestionably appears to be Knife River flint, which had to come from North Dakota—a distance of several hundred kilometers. On the other hand, we cannot completely rule out the existence of another source of material having the characteristics of Knife River flint. Some cherts from the Black Hills area are similar, and until

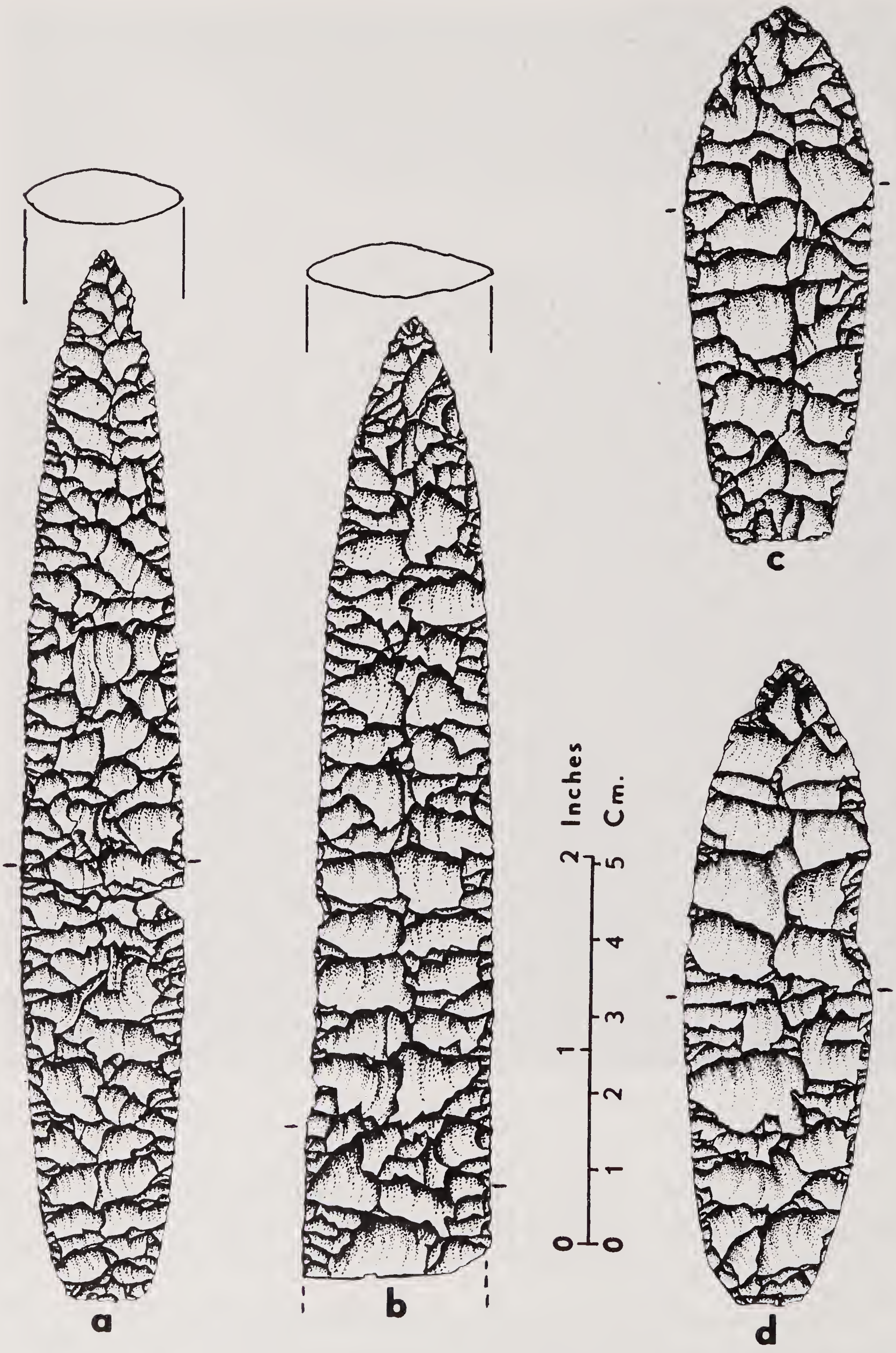


FIGURE 5.6. Projectile points from the Agate Basin site.

more reliable separation methods are devised uncertainties will remain as to sources of some raw materials used in stone flaking. However, from what is known at present, the most likely source of the Agate Basin site flint is the North Dakota one.

Also used at the site were artifacts of chert that probably came out of the Hartville Uplift, about 100 kilometers to the south. But in this locality there are literally hundreds and perhaps thousands of chert sources. Some demonstrate evidence of quarrying; others do not. Taken as a whole, the Hartville Uplift cherts are distinctive in appearance and texture and are derived from a fairly limited area, even though the total variation is great.

Excellent grades of quartzites were found at Agate Basin; these may have come from the Black Hills immediately to the north, the most likely source. On the other hand, there are so many quartzite sources and so much variance within each source that unless very sophisticated means of comparison are developed, we may never be able to give reliable information on quartzites used at the Agate Basin site. However I do not think the source was the large Spanish Diggings quartzite quarries in the Hartville Uplift area because these are quite distinctive in appearance.

The projectile points at the Agate Basin site demonstrate the usual range of quality of workmanship found in nearly all bison kill sites. Some are outstanding, most are quite good, and a few seem barely functional. The exact manufacturing site of the Agate Basin projectile points is unknown, and as a result we lack evidence of the entire production system. Undoubtedly the knappers used several preform stages, especially on those points that are extremely well made. Only rarely can one discern the flake scars from a previous preform stage in the final product. There is, however, one such example. Toward the distal end on one side of this projectile point large percussion flake scars from an earlier preform stage are visible where the final pressure retouch stage did not meet in the center.

General characteristics of the Agate Basin site projectile points include a lenticular cross-section with a delicate final retouch, giving almost perfectly straight blade edges, and eliminating ridges between flake scars. Blade edges are straight and in no case was a twist observed from one end to the other. The final pressure retouch was well executed, was at right angles to the blade edges, and extended beyond the center leaving no central ridge. The archetype, as a result, is long, narrow, and lenticular in transverse cross-section; there is, however, a wide variation in thicknesses (Figure 5.6a, b; Figure 5.7a–c). In outline, the base is rounded and achieved by an ever-increasing inward taper that usually begins about one-third of the distance from base to tip. Moderate to heavy grinding is present this entire distance. Longitudinal cross-section taper evenly from the base to the widest part of the point and taper evenly again to the tip.

Variations are usually the result of reworking broken specimens. As in all bison kills where large projectile points were used, broken pieces that were large enough were modified slightly for reuse. Apparently there was a wide

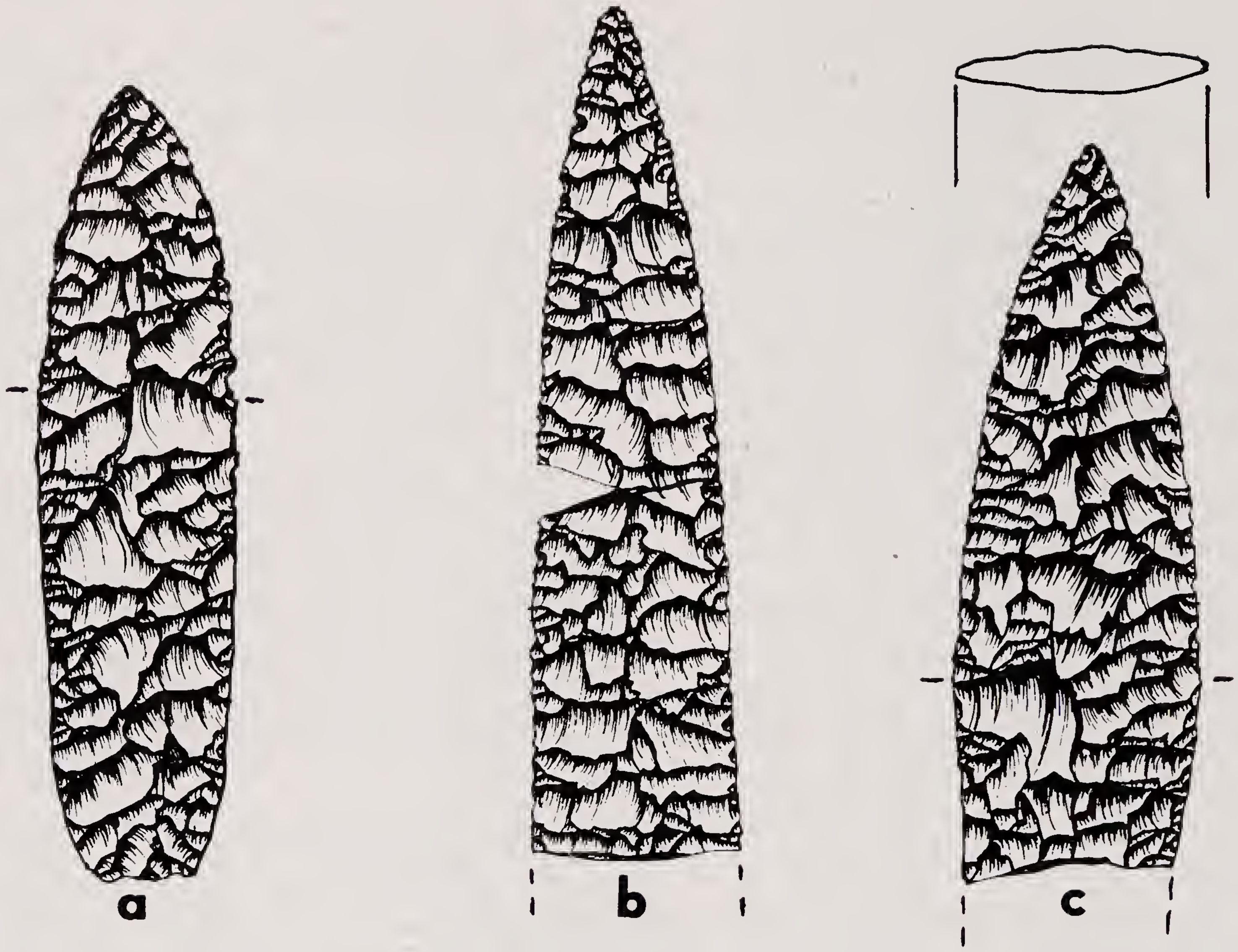
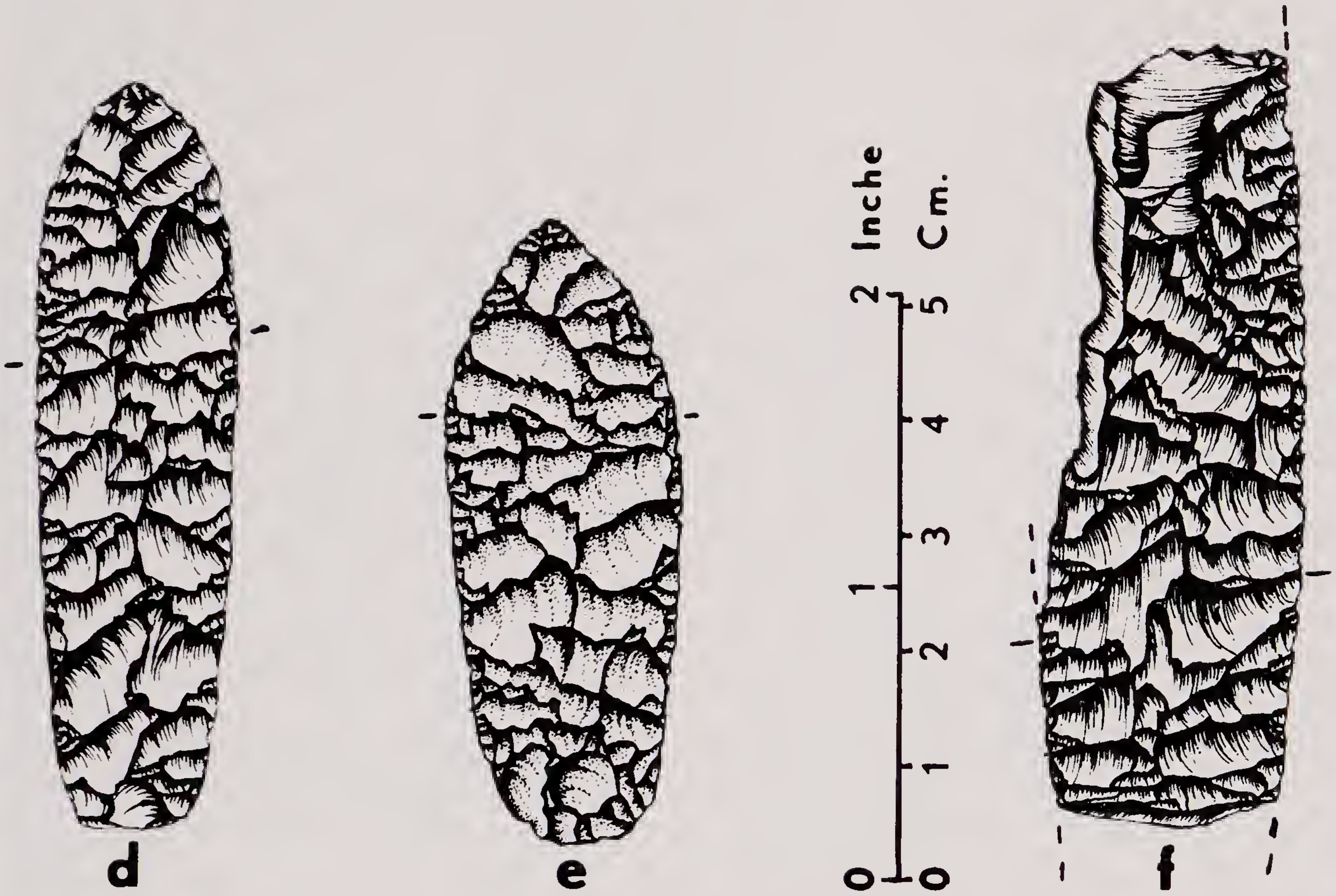


FIGURE 5.7. Projectile points from the Agate Basin site.

range of acceptability in functional projectile points with regard to size and weight. It seems reasonable to assume that the flint knappers made projectile points larger than necessary because they realized that normal breakage would leave a significant percentage of broken pieces that could be reused.

It is quite easy to determine reworking of both bases and tips visually. The reworking was quite carelessly done and interrupts the original flaking pattern. Distal ends are tapered much more rapidly than originally (Figure 5.6c, d; Figure 5.7d, e) and the evenly tapered longitudinal cross-sections are noticeably interrupted. The knappers primary aim was apparently to achieve a sharp, penetrating point and, although in archtype form every effort was exerted to achieve symmetry, after it was broken the reworking was not always so.

The same philosophy held true if the base was broken transversely. If the break was very close to the base the only modification was to grind the corners smooth. In at least one case there were short, burin-like spalls driven distally along the blade edges, presumably to narrow the base, and a moderate grinding was applied over this. In other cases some basal thinning was done. This is distinctive because the knappers usually left the base straight or slightly concave rather than rounded (Figure 5.6c). Some specimens demonstrate reworking of both base and point. This can usually be determined by the outline form, the interruptions in the longitudinal cross-sections, and the difference in quality of the flaking on the reworked part compared to the original.



With regard to hafting of Agate Basin projectile points, we are still very much in the realm of conjecture. We can probably assume that the grinding of edges on the base represents the distance a sinew binding was expected to cover. I have experimented with two hafting methods. One uses a foreshaft with a socket for the projectile point; the other uses a foreshaft with a split end. With the socket, the sinew binding does not touch the projectile point, which is held in the socket by the pressure of the sinew binding along with pitch. This method of socketing is a little more difficult to achieve but results in a more tightly held point than the split shaft. On the other hand, I and others have had good success with the split shaft using sinew along with pitch or a mixture of pitch and beeswax. In practice (spearing domestic cattle and bison), excellent penetration was achieved using both hafting methods with Agate Basin projectile points. As long as the pressure is that of pure thrust, parallel to the spear shaft, one method of hafting is about equal to the other. But wild animals do not always present the ideal target and stand broadside waiting for the hunter to thrust his spear or throw his dart; as a result, the projectile point does not always meet the animal at exactly a right angle to the point of entry. When this occurs—and it is more the rule than the exception—pressures at other angles occur and then the socketed hafting method appears to be somewhat superior.

Postulations on Past Activities at the Agate Basin Site

The conclusions from the 1975 and 1976 investigations of the Agate Basin site are that it represents a bison trap in an arroyo. Apparently the hunters crowded the animals up a steep-sided arroyo until a knickpoint or perpendicular wall several feet in height was reached.

The site was not a bog but may have been wet or muddy at the time of the kill. If the calving period was the same then as now, which seems almost a certainty, the Agate Basin kill occurred between 1 and 2 months before calving time—probably in late February or early March. A good deal of the butchering of the animals was completed in the actual kill location but there was a large processing area nearby where many processes of preparation of the animal products were accomplished. The nature of many of these processes is not yet well understood. We do not know the size of the original kill or processing area because of subsequent gully erosion, nor do we know whether the kill operation was a single event, several closely spaced events in a single year, or several events at about the same time of year but over a period of more than 1 year. Continued excavation and analysis may eventually yield a better site interpretation.

The excavations in the supposed butchering–processing area at the Agate Basin site revealed a situation typical to that of many other sites covering long time periods where the same or similar activities were performed. There were no prepared fire pits or hearths nor were stone-boiling pits like those found in Late Prehistoric sites present. On the other hand, it is strongly suggested that some kind of cooking and extraction of bone marrow was taking place. Perhaps some sort of aboveground container, such as a green hide or bison paunch supported with sticks, was used. There is evidence of fire along with several fire-fractured stones that would support the idea of the use of the latter in cooking.

Very little can be said about butchering at the Agate Basin site. Most bone in the kill area was disturbed and what was *in situ* was not sufficient for a complete butchering analysis. Bone surfaces were also badly deteriorated and the more common butchering marks from cutting were not observable, although the more evident chopping marks and hammerstone breakage on bones was noted (see, for example, Frison 1970a, 1974b). There was some deliberate breakage of long bones, for example at the distal ends of tibiae and radius–ulnae to remove feet, but for the most part butchering appears to be a dissection process where ligaments were cut and entire long bones were taken to the processing area, where they were broken. Tool marks appear on the trochlea of several femora, a common butchering process to gain access to the patella, the origin of several main rear leg muscles. As already noted, the number of undisturbed bones in the kill area was not enough to give a satisfactory idea of the composition of butchering units and how they were being cut up (dissection or breakage). There is a question also as to whether all the bones in the butchering–processing area represent food retrieval activities. There were a large number of both front and rear foot units consisting of bones distal to and including metatarsals and metacarpals, which contain relatively little edible meat product. The butchering–processing area investigated contained a large number of mandibles but few skull parts. Mandibles recovered here were mostly complete and had been removed from the skulls without breakage. There was no attempt to break open the ventral borders of the mandibles to gain access to the internal cavity and its contents; this is a common occurrence in many sites. Perhaps the tongues were left with the mandibles during the

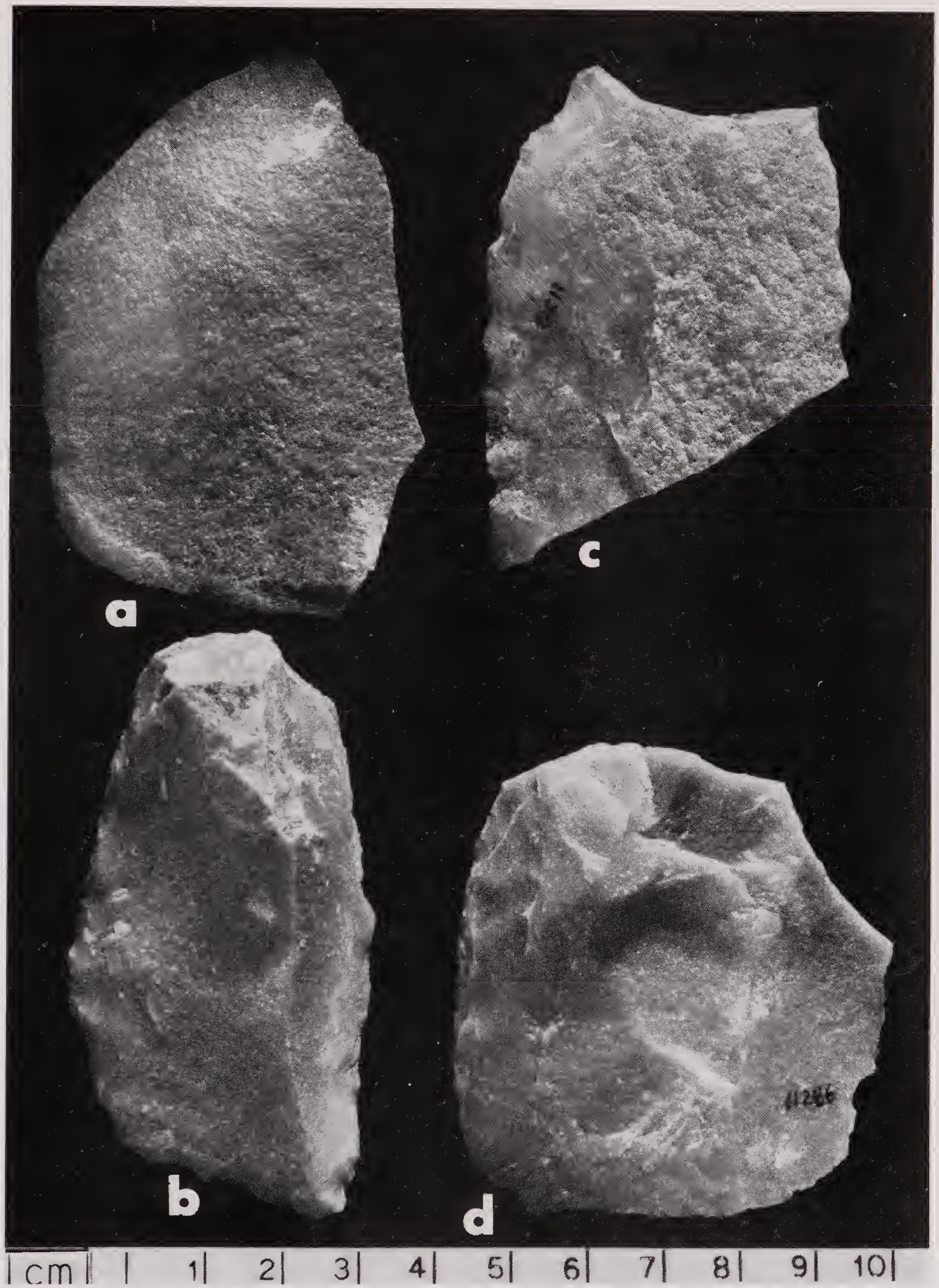


FIGURE 5.8. Flake tools from the Agate Basin site.

initial butchering and the entire units were then taken intact to the processing areas, since most mandibles recovered were still paired. Further investigations at the site may give us more details of butchering processes.

The chipped stone tool assemblage from the butchering–processing area was similar to those found at other butchering areas in other sites covering a wide time range. The assemblage consisted of a variety of large cutting and

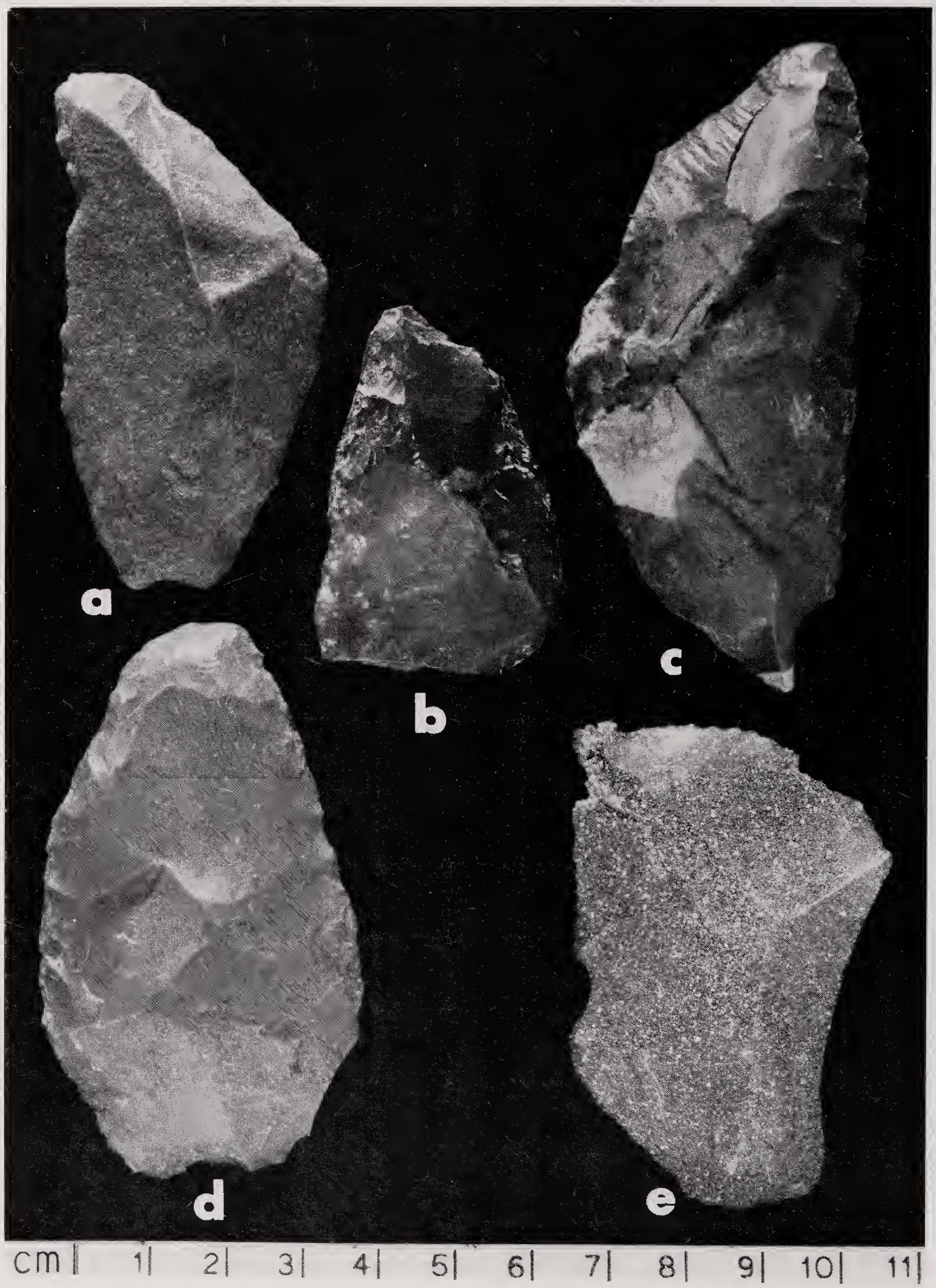


FIGURE 5.9. Flake tools from the Agate Basin site.

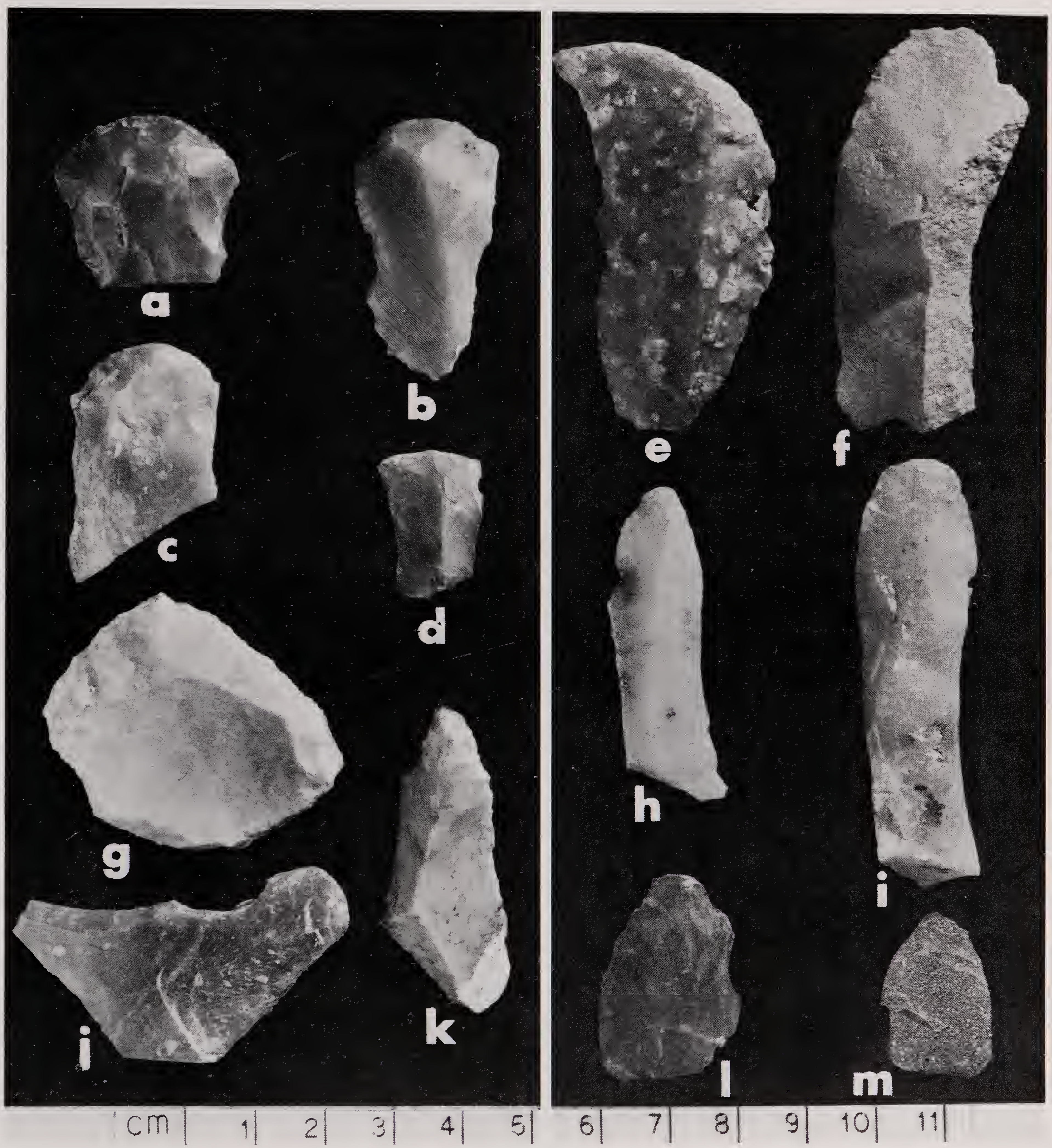
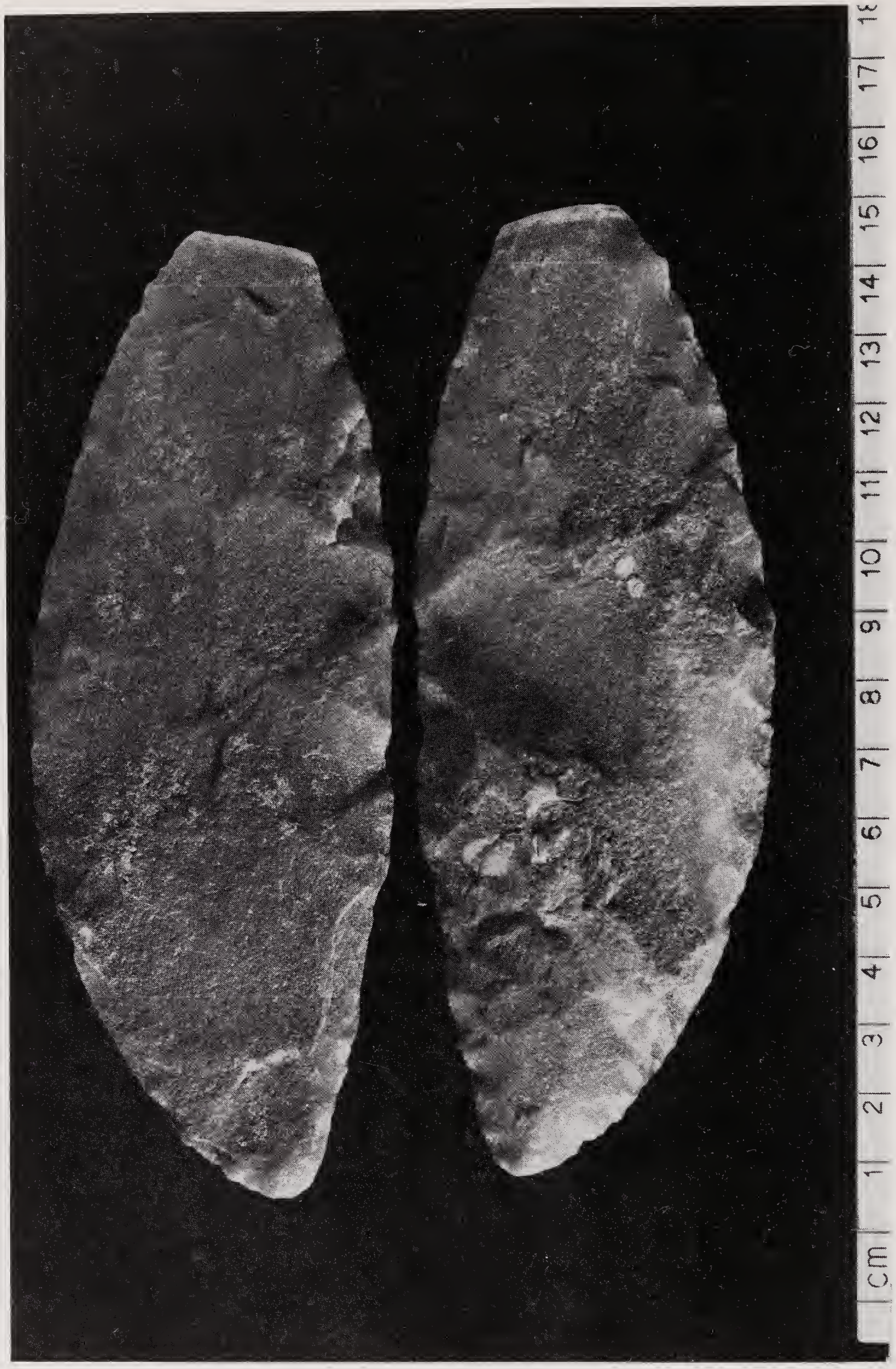


FIGURE 5.10. Scraper (a–d) and flake and blade tools (e–m) from the Agate Basin site.

FIGURE 5.11. Biface tool from the Agate Basin site.



scraping tools (Figure 5.8; Figure 5.9), as well as several end scrapers (Figure 5.10a–d) and a wide assortment of retouched flake and blade tools (Figure 5.10e–m). The tool assemblage is not an aesthetic one but it is functional. One biface butchering tool (Figure 5.11) made from a good grade of quartzite is an exceptionally functional design. This is known from experiments on bison carcasses. Flaking materials used in tool manufacture are about the same ratios as those used in the manufacture of projectile points.

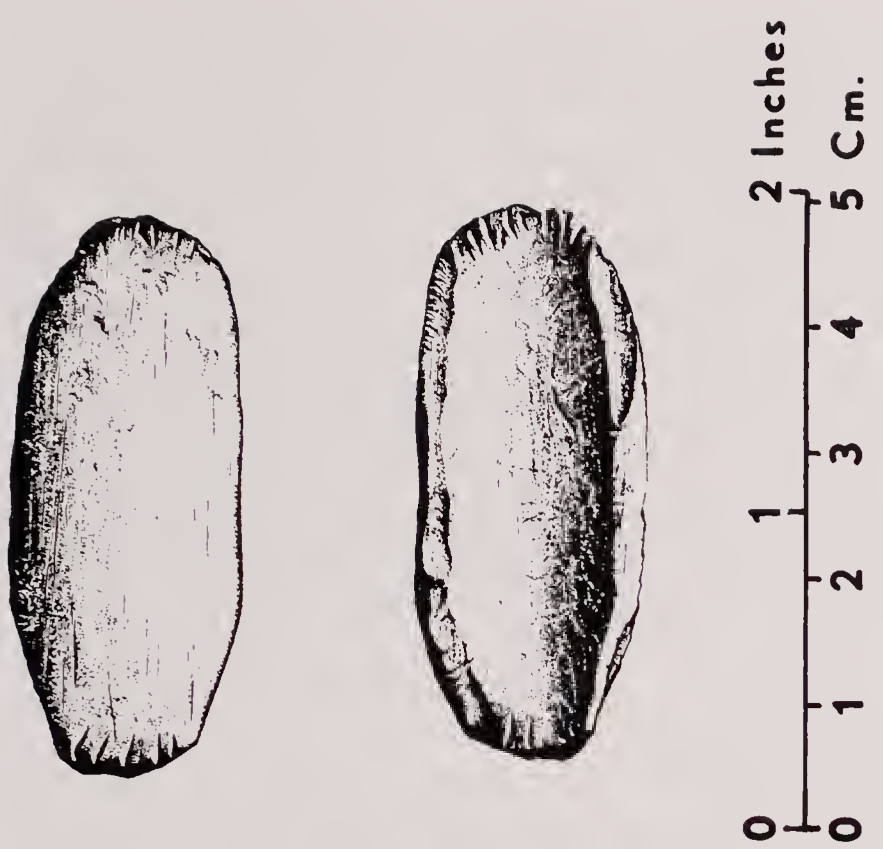


FIGURE 5.12. Worked bone from the Agate Basin site.

I have also presented evidence and arguments for bone butchering tools at the Casper site, where unusually good bone preservation allowed better opportunities to observe breakage and wear patterns (Frison 1974b:35–57). Some evidence for bison tibia choppers (Frison 1974b:Figure 1.17) can be argued at Agate Basin but the scalloped-edge, bison humerus flesher tools (Frison 1974b:Figure 1.14b) were not found. If the latter were present, bone deterioration could have destroyed the working edges of tools of this nature more effectively than those on tibia choppers whose working edges were of heavy long bone. A single piece of worked bone (Figure 5.12) was recovered at Agate Basin—it was probably a piece of antelope or deer long bone.

I am aware, from experiments in spearing domestic cattle and bison, that as the blade edge of a projectile point comes into sharp contact with a bone such as a rib when it penetrates the rib cage, long slivers resembling burin spalls are sometimes removed along the blade edge beginning behind the tip and extending varying distances toward the base. Projectile points in prehistoric bison kills often demonstrate this same phenomenon (see, for example, Frison *et al.* 1976:44–45).

Examples appear on two projectile point midsection fragments from the Agate Basin butchering–processing area, and each may have resulted from either impact or deliberate burination. However, on another midsection fragment (Figure 5.7f) there is a series of five superimposed burin spalls, one over the other, along one blade edge. None of the spalls were recovered and no evidence of use can be detected on the edge formed by the removal of the last spall. The spalls may have been used as tools. This particular specimen is difficult to accept as the result of accidental burination caused by impact.

Several kinds of impact flakes were described from those recovered at the Casper site (Frison 1974b:96–98). These are present also at Agate Basin and a number of those driven off the faces of Agate Basin projectile points could easily be mistakenly identified as parts of channel flakes from a Folsom projectile if recovered out of context. Flaking patterns on finished Agate Basin points are usually quite different than on Folsom projectile point preforms, although this might be difficult to determine in all cases even if the observer were well versed in Paleo-Indian lithic technology. The distinctive striking platforms of true Folsom channel flakes are of course missing.

In retrospect Agate Basin projectile points from the type site demonstrate an excellence in stone flaking technology equaling that of any of the Paleo-Indian groups. This excellence was expressed on a variety of stone types, including charts, quartzites, and Knife River flint. The archetype form demonstrates a rather wide range of sizes, but in outline form all are quite similar. Most deviation from this form is the result of reworking broken pieces and after breakage occurred function was the most important consideration in their rejuvenation for reuse.

Hell Gap Period Bison Procurement

Hell Gap bison procurement is at present the best documented of all the Paleo-Indian periods because of investigations carried out on two large Hell Gap Complex sites. The report on one of these, the Casper site (Frison 1974b), has been published; only preliminary reports are available for the other, the Jones–Miller site, although the excavations have been completed (Stanford 1974; personal communication 1975). This site is located in extreme eastern Colorado near the Nebraska–Kansas border. Although the site is somewhat south of the area this book is concerned with, it does have a strong bearing on Hell Gap materials further north and west. The Jones–Miller site contains the remains of several hundred animals but there is not yet an exact interpretation of the use of any geomorphic feature that may have been a natural trap. It is possible that some kind of artificial corral or other containment was used. There is evidence that it was a procurement operation that covered several months during the winter; it was certainly not a single event. A feature at the site is what the investigator believes to have been a "shaman" pole; close to it were some paraphernalia that could have belonged to a shaman, including a possible antler flute and a miniature projectile point (Stanford, personal communication 1975). This interpretation seems reasonable, since there is archeological evidence for shamanistic activity in Archaic bison kills (see, for example, Frison 1971a) and ethnographic evidence for such activity at a later date.

The results of the Casper site investigations have been published elsewhere (Frison 1974b) but need to be reviewed here briefly if I am to establish a more complete understanding of what is presently known about bison hunting on the Northwestern Plains. In terms of the actual procurement situation, one of the most significant aspects of the Casper site is that here we have indisputable evidence of the geomorphic feature utilized in the procurement process. The feature in question is a parabolic sand dune. Such dunes are common to areas of sand presently stabilized by vegetation but which demonstrate occasional areas of active sand movement. The reasons for these active areas are not fully understood. Parabolic dunes vary in size from a few yards in length to 2000 feet in length, several hundred feet in width, and 50 feet or more in depth. They are usually horseshoe or U shaped with open ends extending to the windward and the closed end or the nose to the leeward. The sides and the nose are generally steep toward the inside with the slope being at the angle of repose of the sand, or around 33°. Often there is a perpendicular drop of 2 or 3 feet at the edge of the dune along the side if the sand is held in place by root growth of plants. For a detailed discussion of parabolic dunes in the Casper site area dune field see Albanese (1974) and also Appendix 1.

The sides of dunes of this nature cannot normally be negotiated by animals such as cattle or bison. The slope is too steep and the animals' split hooves sink into the sand, inhibiting any forward progress. Toward the nose of the dune the sand may not be quite as steep, but the loose sand still inhibits the animals' progress. In rare cases the windward end of the dune is cut nearly perpendicular and may form a barrier impossible for large animals to cross. The parabolic sand dune therefore formed a suitable trap for large animals and was effectively used as such. It is possible that small amounts of brush or other obstacles may have been strategically placed so that the sand would drift more favorably and enhance the effectiveness of the feature as a trap.

The Casper site is an example of the use of a parabolic sand dune for a bison trap. Approximately 100 animals were apparently driven into the dune from the west (windward) and killed in the deepest part of the trough just before it sloped upward toward the nose of the dune (Figure 5.13). Modern analogs of this dune are present today in the dune field adjacent to the site and several of these would make good bison traps (Frison 1974b:21–25). In addition, parts of the dune field area are characterized by interdunal ponds, some of which are quite large and hold water year round. Grass is good in the troughs of many dunes because of the closeness to the water table. Consequently these dune areas were favorite bison locations. It is not uncommon to observe a parabolic dune with a pond of water and tall grass near the opening of the U; further on toward the nose, the sand is active and forms a suitable trap. It is likely that the hunters were able to simply move a small herd of animals from the pond into the nose of the sand dune, and then trap and kill them there. In this kind of situation, there would have been no need to drive or haze the animals for any appreciable distance.

Parabolic sand dune traps are rarely preserved intact because of the nature of dune fields, especially in areas of high winds such as the Casper site area. Vegetation is a major factor controlling sand movement, so even short periods without rain usually bring about some sand movement. The dune field in which the Casper site lies is largely stabilized at present, but the entire area of several hundred square miles demonstrates evidence of sand movement in the past. Very likely there was more than one sand movement in much of the area during the Holocene period. Once the sand is blown from a site such as a bison kill, the exposed bones disintegrate and the only remaining evidence of a site consists of the stone artifacts, which are no longer in their original context. Sites

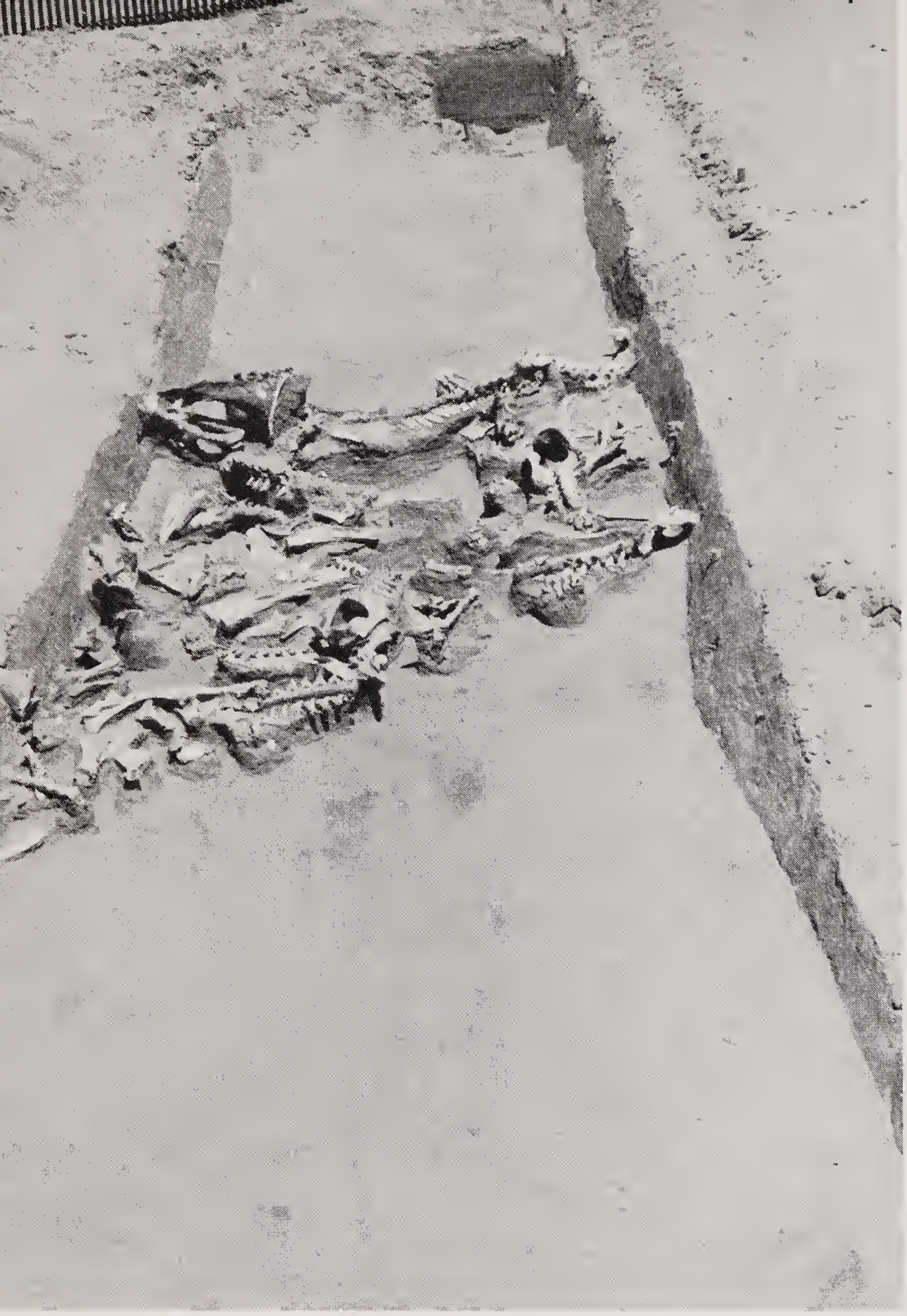


FIGURE 5.13. Butchered bison bone in the bottom of the parabolic dune at the Casper site.

in sand dunes may also be buried up to great depths and stand small chance of being exposed except in accidental circumstances—such as by earth-moving activity related to industrial expansion. This is what happened at the Casper site. If the wind exposes a site and no one is around to observe, the site will be altered, because bone deteriorates rapidly. It would also be unusual for wind action to expose all of a kill site at one time. Once a sand dune kill site is covered (which could happen quite rapidly or require a long period of time), it would be difficult if not impossible to predict when it might once again be exposed. Exposure would depend on a number of subsequent climatic conditions affecting the vegetation cover and thus determining when wind action could again bring about site exposure.

In the actual killing of the animals in this kind of trap, the human group would enjoy one definite advantage. The split-hoofed bison would sink deep into the sand whereas humans would not. Even in winter sand dune activity often continues, unless the sand is wet enough to freeze solid. Snow and sand often move at the same time. Snow may drift first and the sand may then drift

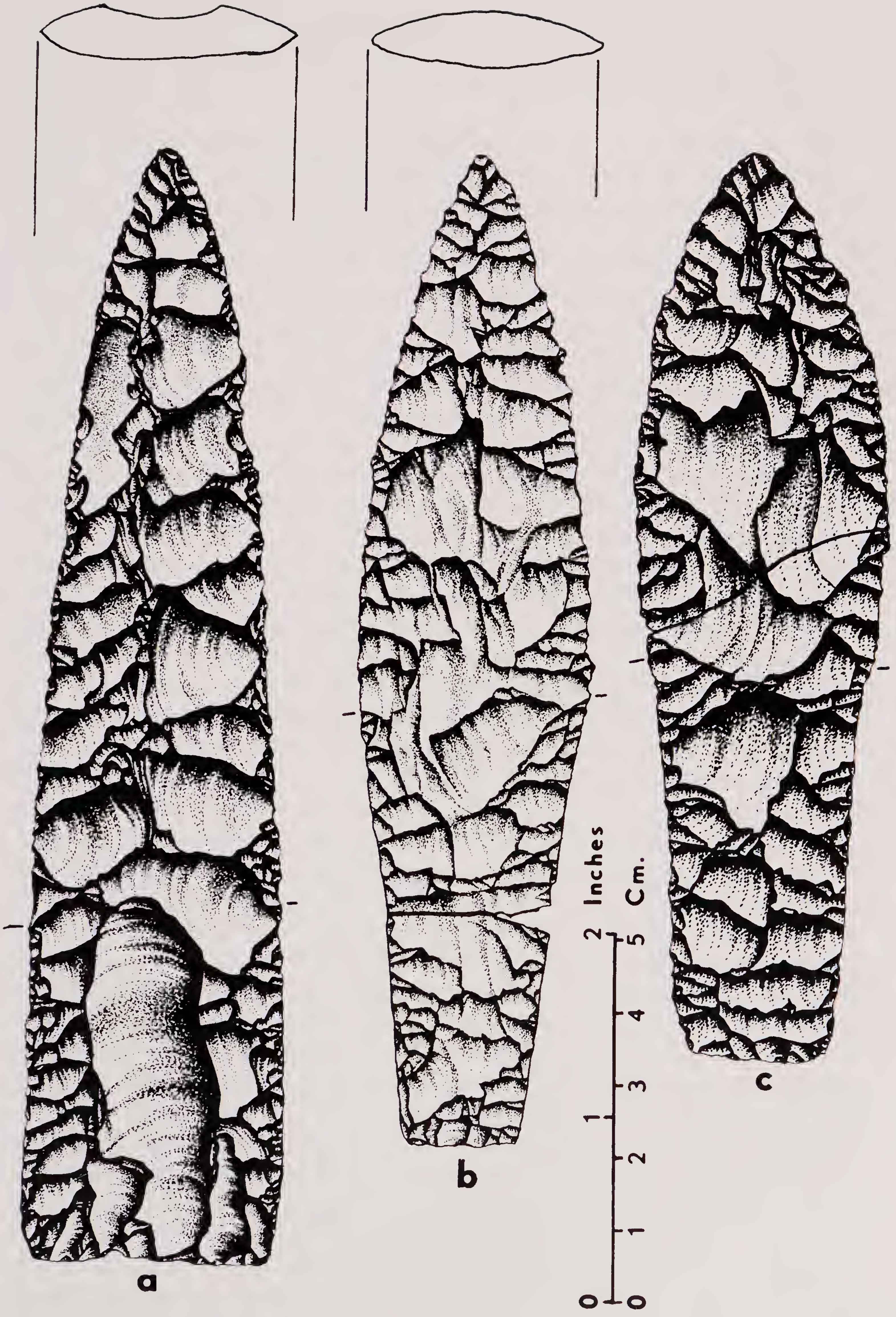


FIGURE 5.14. Projectile points from the Anzick (a) and Casper (b, c) sites.

over the snow and preserve it well into summer (see Steidtmann 1973). From these observations we can postulate that a sand dune trap in winter could be every bit as effective in impeding the escape of bison as at other times of the year.

The Casper site provided a large enough sample of cranial material, both male and female, to allow for meaningful statements regarding species designation. In line with present thinking that Holocene bison can be separated only at a subspecies level, the Casper site bison are called *B. bison antiquus* (Wilson 1974a, b, 1975) although some characteristics of *B. bison occidentalis* may be present. The population study (Reher 1974b) strongly suggests a late fall operation based on ages of immature animals at time of death. The Casper bison seem to have been somewhat shorter-lived than modern bison (about 12 years compared to about 16 years). A high incidence of tooth pathologies suggest some kind of stress, which could have been the result of inbreeding caused by intense human predation combined with a worsening natural environment.

After working in both the Agate Basin site and the Casper site, I see a close similarity between the artifacts of both complexes—especially with regard to projectile points. The Agate Basin point seems to be an efficient bit of weaponry. It is long, has a sharp point for penetration and relatively thick cross-section for strength. About the only drawback to the Agate Basin point is that it is somewhat difficult to haft because of the curved blade edge in the hafting area and thick cross-section. As already mentioned, the best solution in terms of functional utility would have been in a socket type of haft.

The Hell Gap point (Figure 5.14b) appears to be only a slight variation of an Agate Basin point. Perhaps the final pressure flaking on the Casper site points is not of the excellence observed on the points at the Agate Basin site but the hafting part is definitely improved. Instead of a curving blade edge, the hafting areas on the blade edges of the Hell Gap points are straight but expand from the base toward the tip. There is a noticeable shoulder or expansion of the point before the blade edges taper inward to the tip—so in general the Hell Gap points are wider than Agate Basin points. For purposes of hafting, the expanding stem with a slight shoulder on a Hell Gap point seems a better design than that of an Agate Basin point. The tapering edges are ideal for a socket and the design is such that the force of impact is evenly distributed in the socket. Any movement of the point backward as a result of impact simply tightens the projectile point in the binding. From experiments on cattle and bison, I have found both a socket and a split wooden haft to be functional. But, as in the case of Agate Basin points, the socket with a sinew wrapping is superior in strength to a sinew wrapping and a split haft. Pitch is an important addition to hafting. It is easily applied and forms a bond between the wood and the stone projectile point that is solid but still allows some give on impact.

Nearly all the Hell Gap points are wider than the Agate Basin points. We have not yet experimented enough in the actual use of various types of Paleo-Indian projectile points to determine whether the Agate Basin, Folsom, Hell Gap, or Cody Complex point is most lethal, but we do know that all will successfully kill a bison. The Hell Gap point, however, if properly pointed, sharpened, and thrust into an animal, cuts a large hole and the wide blade slices very effectively into the internal organs as it moves after the entry of the spear. Many of the projectile points at the Casper site demonstrate evidence of heavy impact in the form of a number of impact scars and flakes. We have produced identical impact scars on experimental projectile points by spearing domestic cattle in the rib cage. It should be noted, however, that ribs of domestic cattle are flatter than bison ribs and a projectile point tends to slip off the bison rib and penetrate into the rib cage. The Hell Gap projectile point is an efficient device for bison killing when mounted into a socketed foreshaft and used on the end of a long thrusting spear. It is also effective in conjunction with a throwing stick but at this point we have no way of determining the exact method of use. Perhaps both methods were common.

The sand dune trap is not the kind of trap that would have held a small herd of bison indefinitely. The hunters would have had to kill or incapacitate the leader as soon as possible. In the case of a nursery herd the leader would have been an older female. The next most important to kill would have been the other females with offspring. The calf certainly and even the yearling would tend to stay with the wounded or dead mother and they would have been relatively easy to kill. Many, especially the mature animals, would have tried to escape. If there were no escape routes, they would probably have charged the hunters. In this case the thrusting spear would have been the superior weapon since the heavy spear shaft would have offered good protection to the hunter. A substantial stick is a great aid in working bison or cattle in corrals. It is not used to beat the animals but to prod them through gates and chutes and to provide protection from the occasional charging animal. Mature males were also killed at the Casper site. They may have been driven into the trap along with nursery herd or in a separate group.

I believe that a minimal amount of butchering occurred in the Casper site kill location. Sand is particularly objectionable if it gets on meat and it is difficult to butcher an animal in soft sand without accomplishing just that. A detailed butchering analysis has been published elsewhere (Frison 1974b). These operations were accomplished with a simple but effective tool kit consisting of chipped stone knives, hammerstones, and bone choppers. The butchering process at the Casper site was apparently one that, with minor variations, continued through to the historic period.

The fact that the Casper site location was not favorable for butchering may have been fortunate in terms of our interpretation of the butchering processes. As a result the site provides a good look at only what may have been the parts of bison carcasses left after the desired parts were removed. No processing or butchering area was found—which is not too surprising since it was probably some distance away and probably has been destroyed.

A small part of the Casper site was to be left intact for future study. However, the remaining part was completely excavated in the spring of 1976 because of threatened industrial expansion. Very little if anything was recovered that in any way changes the original site interpretations. The projectile point sample was expanded (Figure 5.14c; Figure 5.15; Figure 5.16; Figure

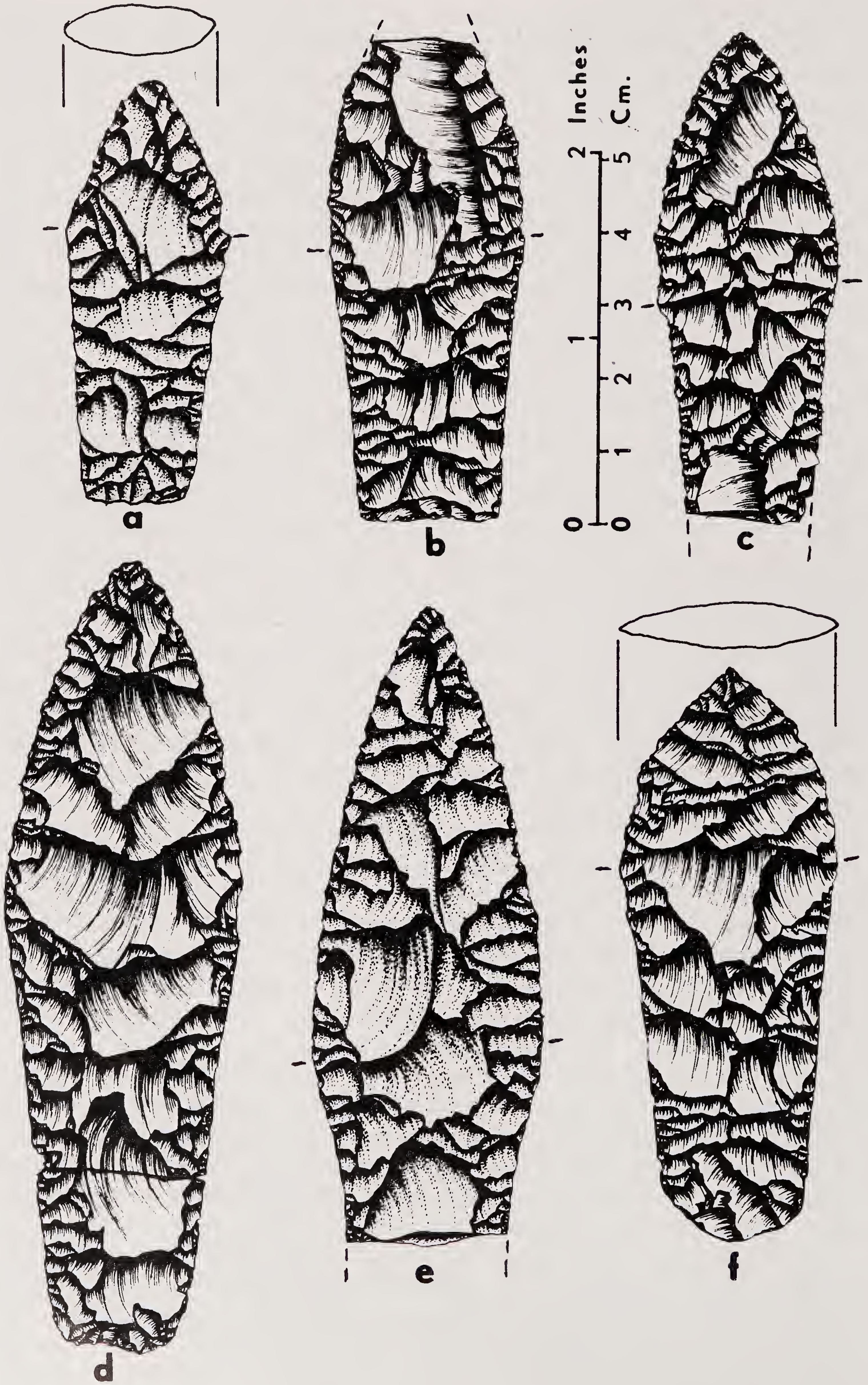


FIGURE 5.15. Projectile points from the Casper site.

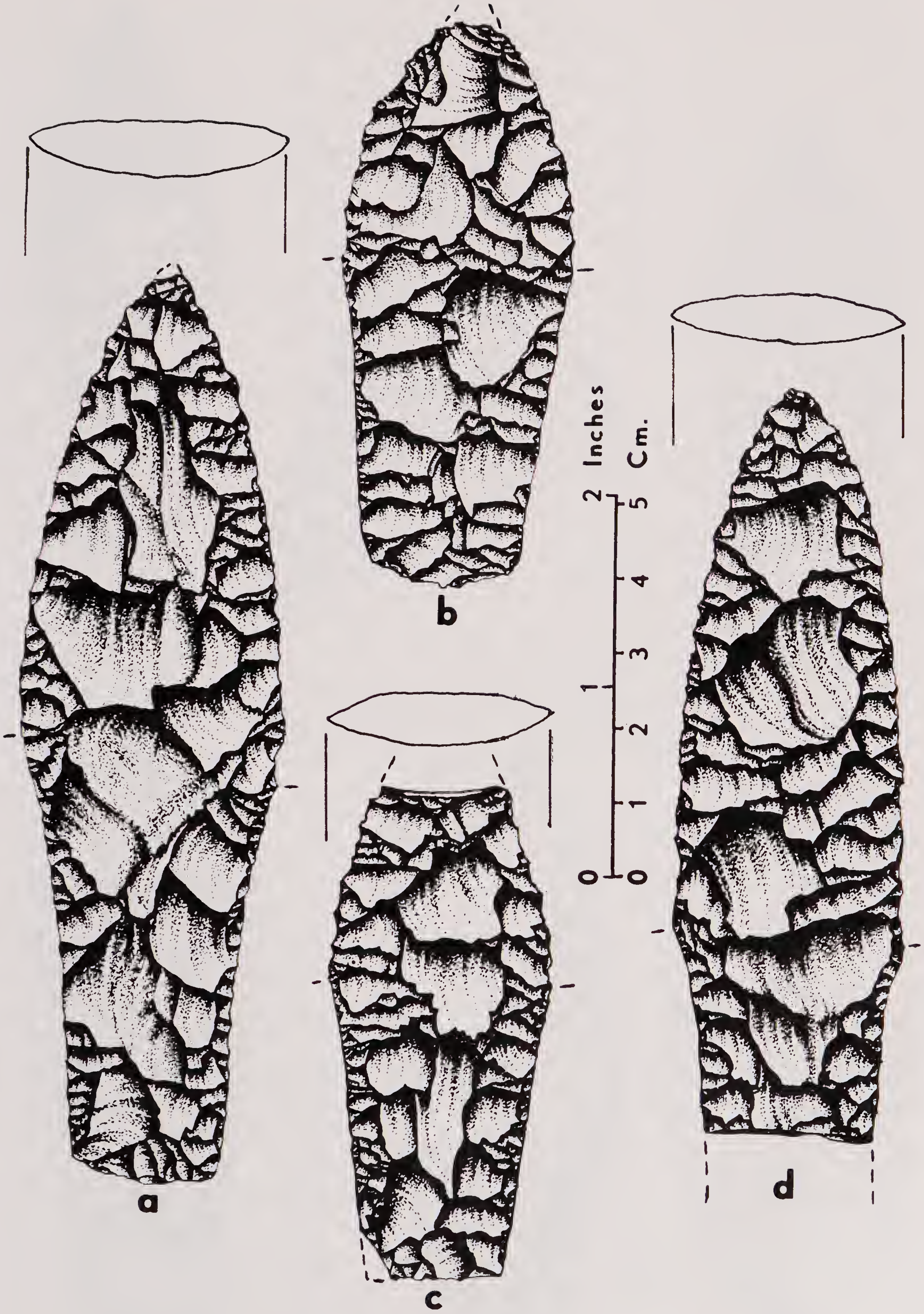


FIGURE 5.16. Projectile points from the Casper site.

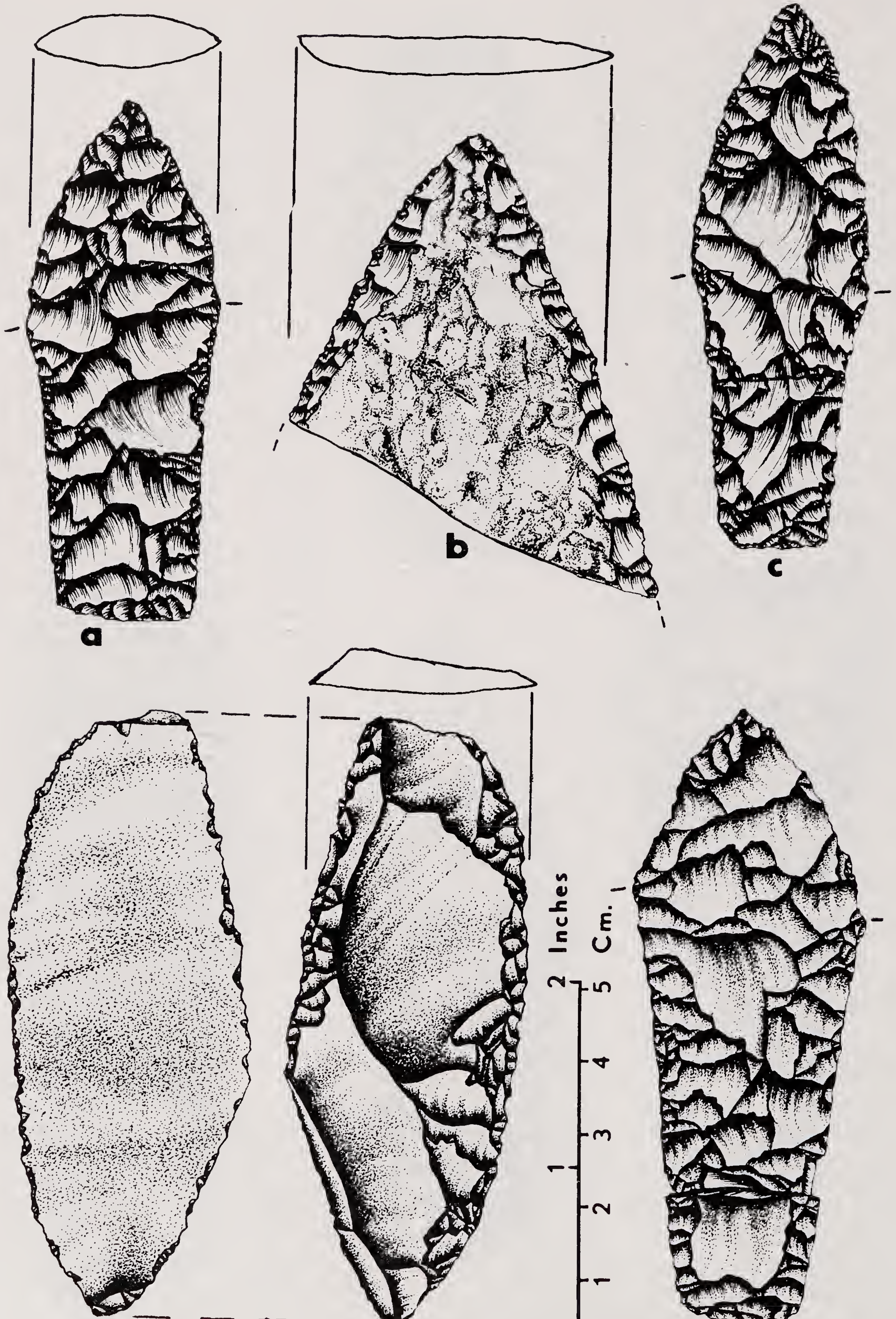


FIGURE 5.17. Projectile points (a, c, f), part of biface (b), and blade tool (d, e) from the Casper site.

5.17a, c, f). Another blade butchering tool (Figure 5.17d–e) and a broken biface tool (Figure 5.17b) were recovered. Several more bone butchering tools were also recovered.

The faunal collection was expanded also. An exceptionally fine skull of a mature male bison (Figure 5.18b) having a horn span of nearly 100 cm was recovered. Perhaps of some significance were several identifiable parts of a camel (*Camelops* sp.) including a metatarsal, astragalus, a distal tibia, and several parts of vertebrae. From the position and treatment of these bones in the kill, it appears that the camel was killed and butchered at the same time the bison were. Several more bison mandibles were recovered and the aberrant trends in tooth morphology noted earlier (Wilson 1974a) are still upheld.

Later Paleo-Indian Bison Kills

The Casper site has been radiocarbon dated at 10,000 B.P. and the next cultural manifestation to appear is Alberta (see Irwin-Williams *et al.* 1973). A large bison kill of this complex under investigation for several years in northwestern Nebraska is known as the Hudson–Meng site (Agenbroad 1973; 1974a, b). The site contains parts of several hundred animals along with projectile points of Alberta type (Figure 5.19a, b) and a complement of butchering tools. At least three radiocarbon dates have been obtained and the one considered the most reliable, 9820 B.P. ± 160 (SMU–224), was derived from charcoal. Bone apatite and collagen yield dates several hundred years later (see Table 2.2). If the charcoal date is correct, and there seems to be no reason to doubt its reliability, it places the Hudson–Meng site essentially contemporaneous with the Casper site.

The investigator postulates the Hudson–Meng site as a possible bison jump since he apparently feels that the terrain at that time was favorable for this kind of procurement operation. However, it could easily have been a trap of some sort also. The exact nature of procurement may never be known because of the landform changes in the site area subsequent to the site activities.

The Alberta projectile point is somewhat different than the Hell Gap point. The hafting part is a true parallel-sided stem with a shoulder that requires some technological changes to haft properly. Upon thrust, pressure is delivered through to the base of the point and, on the Alberta points, the base as well as the stem is ground smooth. A split haft with sinew bindings placed to prevent the point from being driven backward and splitting the shaft upon impact was necessary. The shoulder of the point probably took on significance also, since upon heavy impact it had to absorb some of the shock. The technological solution to these hafting problems was not difficult using pitch and sinew. Alberta points are relatively large and quite heavy and the hafting part or stem is also quite large but not out of proportion to the rest of the point. A complete report on the Hudson–Meng site is in preparation.

The Olsen–Chubbuck site (Wheat 1972) is dated at 8200 B.C. ± 500 (A–744) as determined from bone collagen. If the date is correct the site is in the same time period as the Casper and Hudson–Meng sites. Olsen–Chubbuck, a Central Plains manifestation, is one of the few Paleo-Indian sites for which

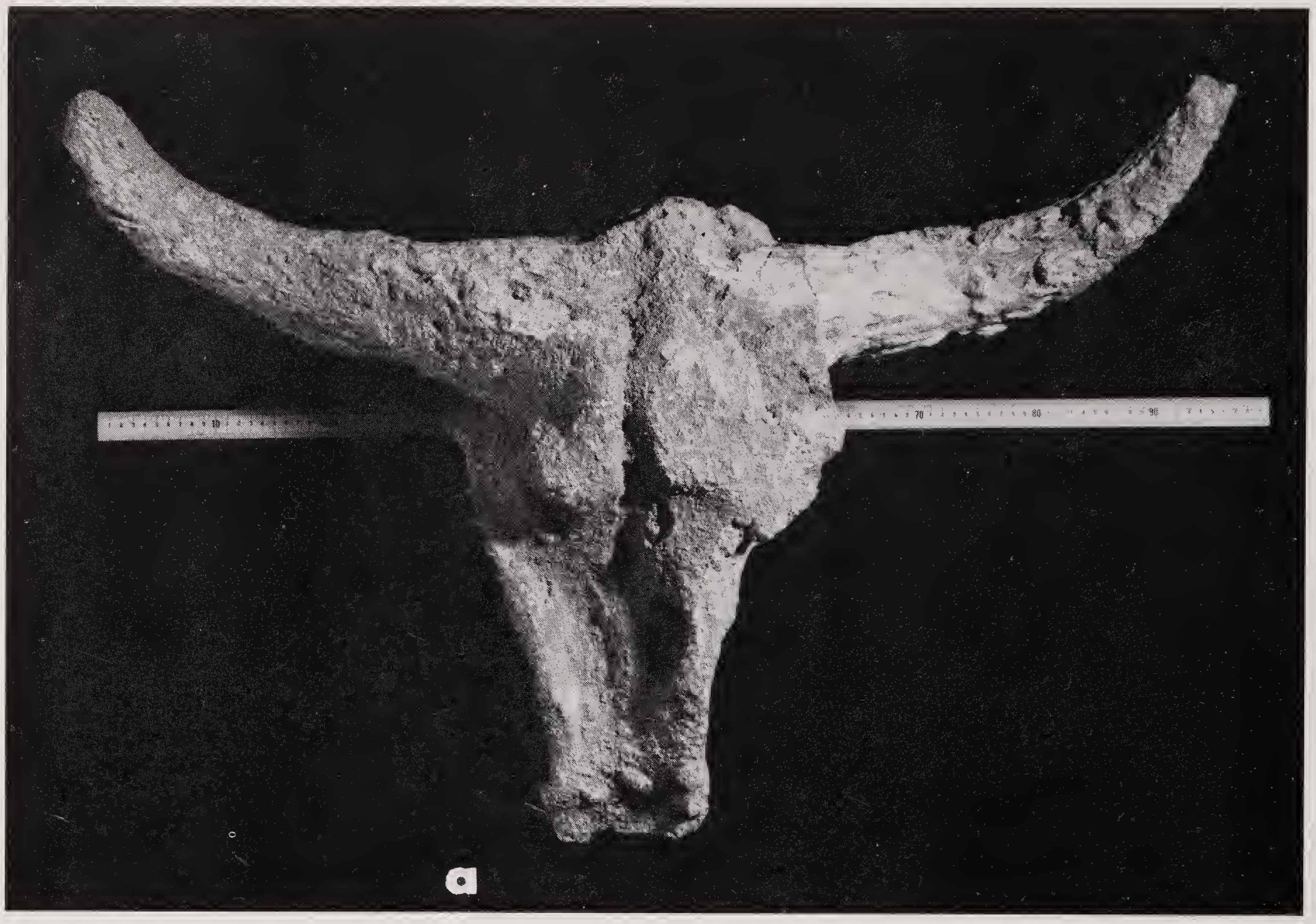
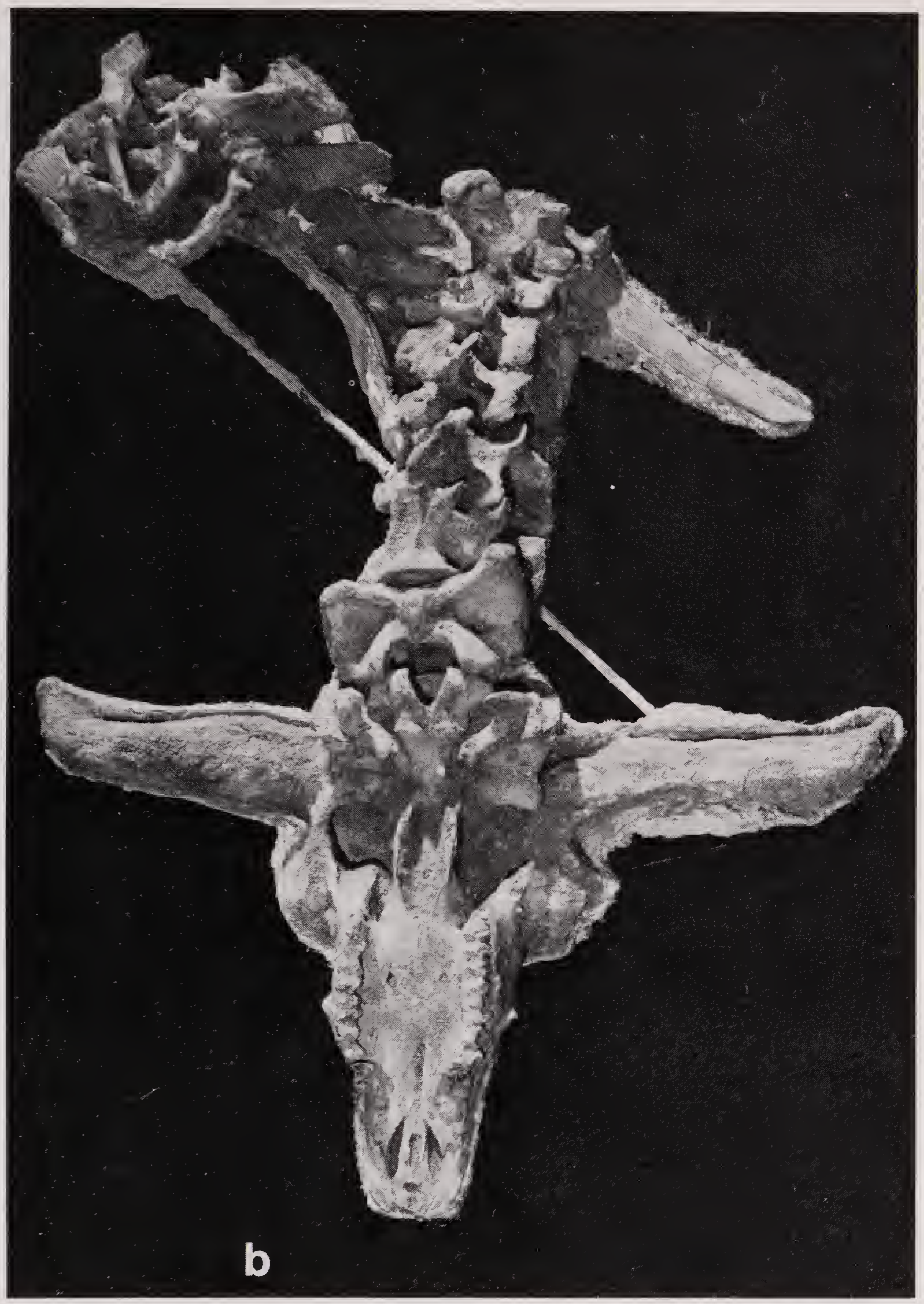


FIGURE 5.18. Male bison skulls from the Casper site. Tip-to-tip spread of (b) is 97 cm.

there remains little doubt of the geomorphic feature involved in procurement. The bison involved were stampeded into a deep, narrow arroyo, resulting in the killing of about 200 animals of all ages and both sexes. It was regarded as an early spring kill event for some time, but the advent of more sophisticated techniques of determining bison age indicates a kill later in the year—probably in the summer or early fall (see Frison 1974b:18; Chapter 7, Fig. 7.6).

The procurement situation at Olsen–Chubbuck appears to have been one of great success and a model of efficiency, at least in terms of killing animals. We might wonder why more sites of similar nature have not been found, since arroyos of the same or similar nature are a common geomorphic feature of the terrain in many areas of good bison habitat. It may be that there are many more undiscovered similar sites. Quantities of bison bone in arroyo bottoms do preserve quite well. Another possible explanation is that although these kinds of kills were effective in killing bison, they did not leave the dead animals in a favorable enough location for butchering and processing. A deep, narrow arroyo filled to the brim with dead bison cannot be regarded as a happy task to face in terms of salvaging the products of the kill for future consumption. Human groups wise in the ways of hunting might have generally preferred to



utilize more favorable locations and have the dead animals where they could be butchered and processed more easily. Certainly a significant quantity of the Olsen-Chubbuck meat products were lost.

Along the same lines, it would appear that we as archeologists fail to credit the Paleo-Indian with the ability to systematically obtain bison on terms set up by the human groups rather than those set up by the animals. There is no reason to assume that the Paleo-Indian was forced to utilize for bison procurement geomorphic features that jeopardized the quality of the meat, or added greater measures of work to the task of butchering and processing—even though the

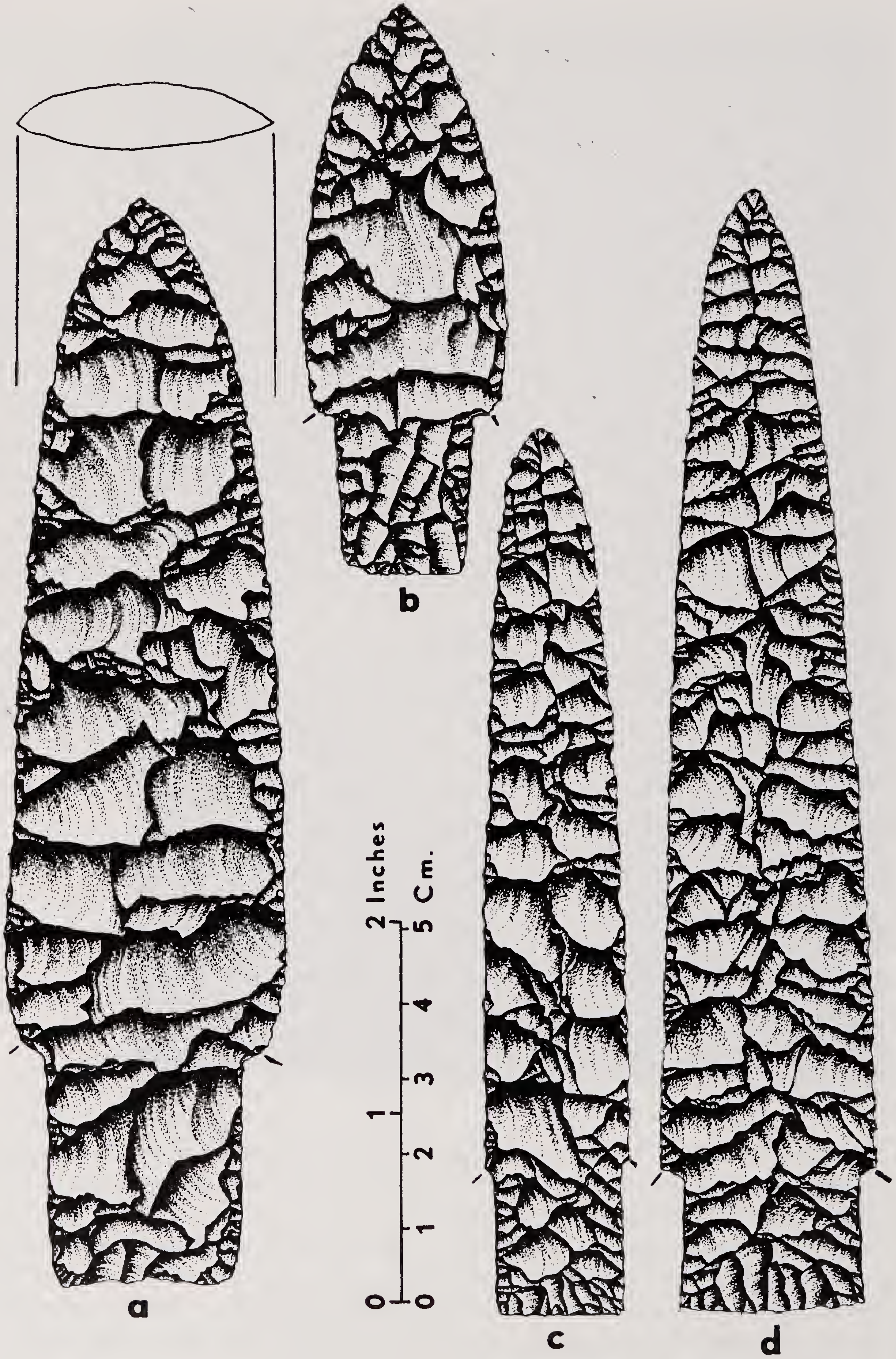


FIGURE 5.19. Projectile points from Hudson–Meng (a, b) and Horner (c, d) sites.

actual killing of the animals may have been easier. The experienced hunter soon learns that most of the time he can manipulate the animals to a point where he can obtain them on his own terms. I offer this as one hypothesis to explain the apparent lack of more Paleo-Indian sites analogous to Olsen–Chubbuck.

The Cody Complex; The Horner Site and the Finley Site

Two sites in Wyoming, the Horner site in the northern Bighorn Basin and the Finley site in the Green River Basin, both the scene of large-scale bison procurement operations, seem to represent the climax of late Paleo-Indian bison hunting. The Horner site is located at the edge of a steep incline about 45 m high overlooking Sage Creek, which flows into the Shoshone River a short distance north of the site. The V formed by the confluence of Sage Creek and the Shoshone River is a relatively flat terrace and the edges are deeply dissected in places by small arroyos, some of which are quite narrow and deep because of the steep gradient from the terrace edge to the streams. A mile or so away from the Shoshone River the terrace disappears into the low hills of the interstream divide that characterize the interior basin. The part of the terrace in the vicinity of the Horner site has not been farmed and the original vegetation cover, mostly sagebrush and bunch grass, is present. Stream bottoms are lined with trees and brush thickets. The area apparently supported a sizable bison herd that was being exploited by the Paleo-Indian hunters.

The Horner site covered over 1000 m^2 on top of a gravel terrace. A thin layer of soil caps the gravel terrace and the bone and artifacts were covered by only a few inches to a foot or so of this soil. None of the original site area remains intact, unfortunately, because of the desire for ownership of Cody Complex projectile points from the site and the relative ease with which the site deposits can be dug into.

The actual conditions under which the Horner site bison were contained and killed is pure conjecture and will probably remain so unless gully erosion, earth-moving, or archeological work uncovers a kill site. The site may be a butchering–processing area where butchered units were taken, or it could be the location of the actual kill. There are many possibilities. The bison may have been stampeded into an arroyo; there may have been an arroyo trap nearby; there may have been a holding structure or pound present. Perhaps some other, entirely different, method of containment and killing was employed. Whatever the situation, the investigator (Jepsen 1953) believes the site to be a fall or early winter kill of about 200 bison and analysis of a small sample of ageable teeth confirms this. Whether it was a single year's effort or several recurring events covering a period of more than 1 year is not known. The Horner site promises to be a continual source of speculation on Paleo-Indian bison procurement methods, and the probability of finding answers is good. Horner site projectile points are prime examples of the Cody Complex and both the Eden (Figure 5.19a) and Scottsbluff (Figure 5.19b) types are well represented. There were also a number of the distinctive Cody knives recovered.

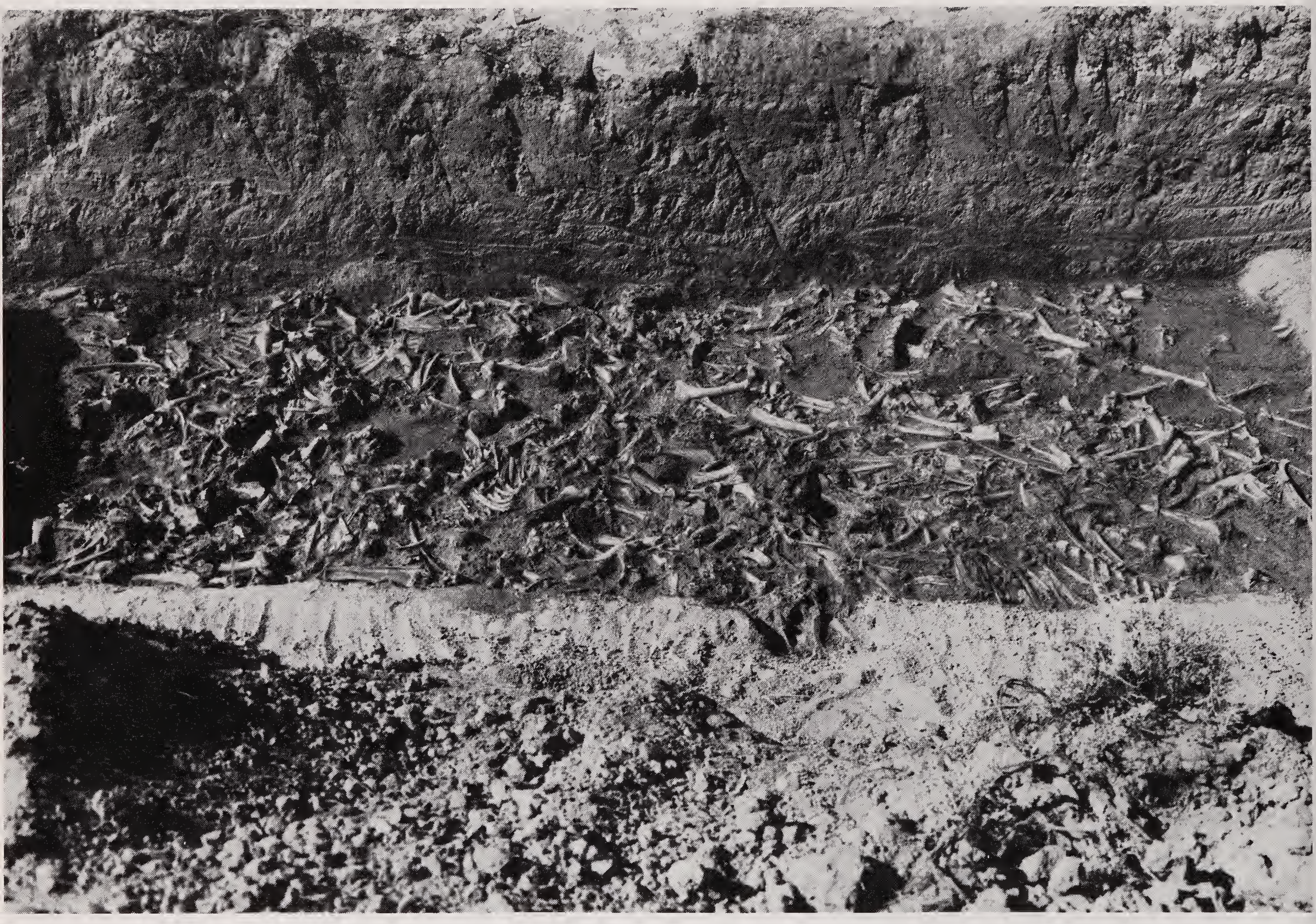


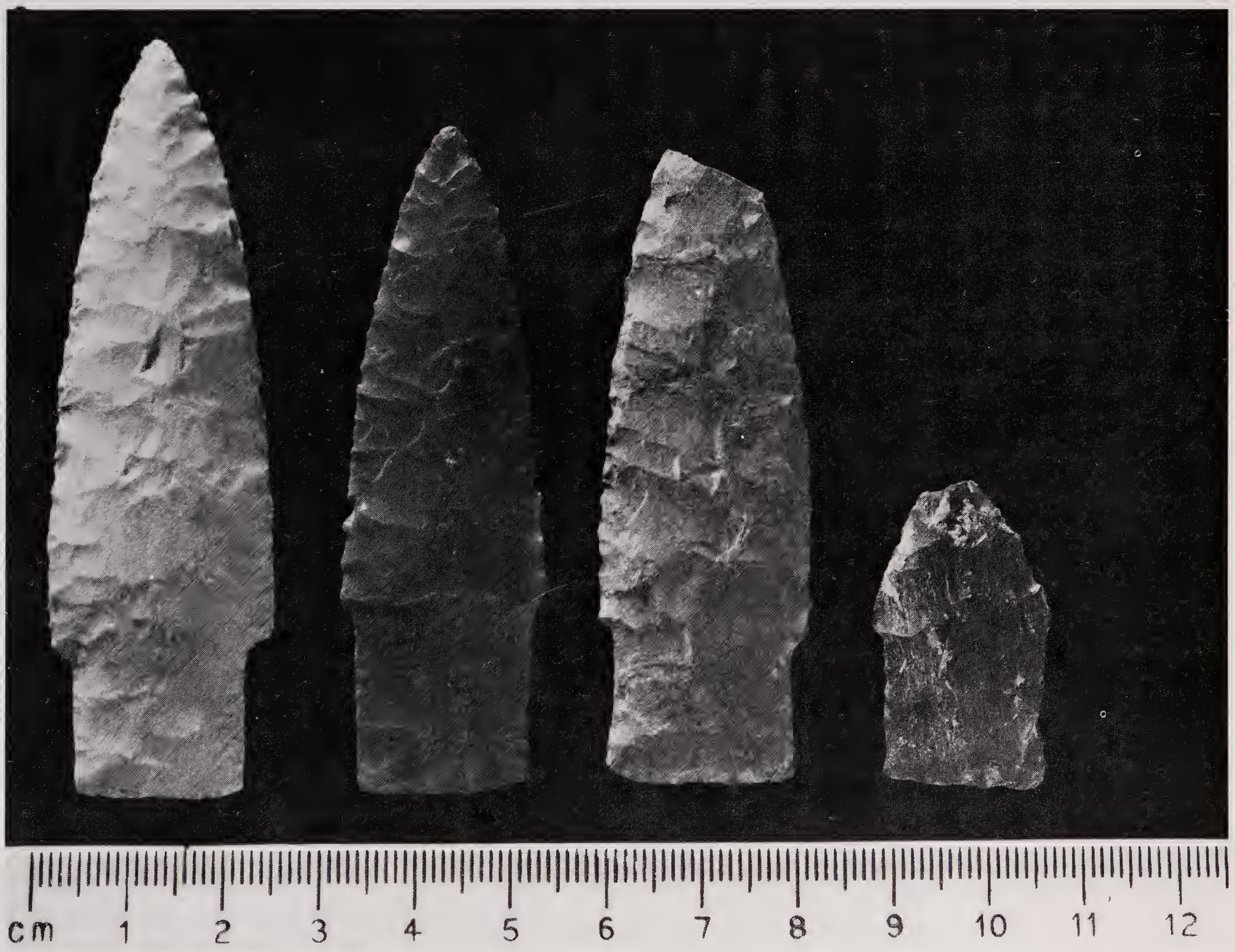
FIGURE 5.20. Bone bed exposed in 1977 excavations at the Horner site.

The Horner site materials collected during the investigations in the late 1940s and early 1950s are now being prepared for final analysis and publication. During trenching operations for geological studies at the site in 1977, another part of the site area was discovered about 50 m south of the original site location and buried under nearly 2 m of alluvium. A shallow arroyo about 6 m in width contained butchered bison bone (Figure 5.20) and the butchered units vary from single bones to one nearly complete animal. The area tested yielded projectile points (Figure 5.21) and a few tools. Indications are that the bone bed area will be quite extensive.

The Finley site, like the Casper site, is located at the periphery of a large sand dune field, part of which is one of the larger presently active sand dune areas of North America. The site has undergone a good deal of investigation since its discovery in 1939 by O. M. Finley (see Howard 1943; Howard *et al.* 1941; Moss *et al.* 1951; Hack 1943). Like the Horner site, the Finley site has undergone a good deal of digging by persons in search of Paleo-Indian projectile points. However, during 1971, 1972, and 1973 there has been a recovery of additional data from the Finley site that tell us quite a bit more about the associated bison and their procurement.

The Finley site as described (Moss *et al.* 1951) is located in an area of stabilized sand dunes about a quarter of a mile east of a spring and associated bog area (Figure 5.22). The spring apparently results from precipitation that falls on a large area of sand dunes underlain by an impervious stratum. The spring runs strongest in the spring and tapers off in late summer but does produce some water year round. The water forms a bog area for several hundred feet beyond the spring source. The bog presents a danger to cattle in the spring of the year, especially to older animals that are relatively weak from the winter.

FIGURE 5.21. Projectile points recovered in 1977 excavations at the Horner site.



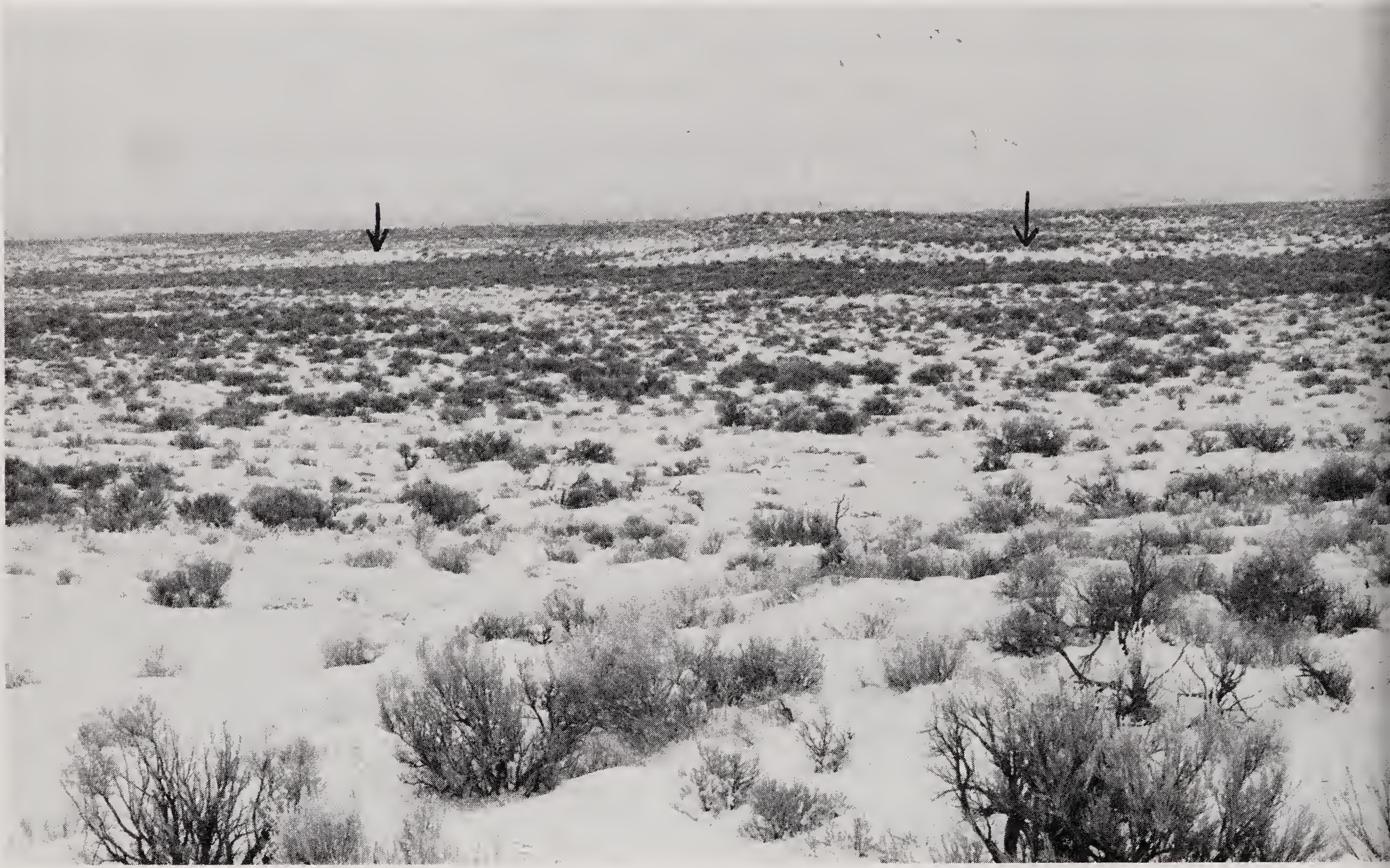


FIGURE 5.22. View of Finley site area in winter. The kill area is located at the left arrow and the early excavation at the right arrow.

Cattle graze the bog in summer and it presents no problem to healthy cattle then, even though they may sink to above their knees in the mud.

The area excavated at the Finley site produced a number of bison bones—mostly foot bones such as distal metacarpals, metatarsals, and phalanges; very few long bones were found. The evidence from the bone frequencies suggests some kind of specialized processing area rather than a kill area.

In the late 1960s wind action began to uncover bison bone in a sand dune about 200 yards north of the original Finley site excavations. Investigation of this phenomenon revealed two things:

1. The bones were not *in situ*.
2. The bones were not from modern bison but from a larger variant.

Further investigation yielded a large quantity of carelessly excavated bone, as well as a few articulated units that apparently had not been moved because they were slightly deeper and surrounded by sand that had been partially cemented by caliche. Recovered also were three projectile point fragments of the same types as in the original Finley site investigations. The bone was recovered and an analysis of it and the context in which it was found offers some further evidence as to the actual nature of the Finley site as a Paleo-Indian bison kill.

The bone in question was probably discovered not too long after the site excavations were completed in 1942. Most of it must have been dug out by projectile point hunters who went to the trouble of replacing the bone and covering it up. The sand covering the bone was subsequently stabilized by grass cover, very likely in the late 1940s as a result of good rainfall years, and the bones did not reappear until the late 1960s when the vegetation cover was somehow disturbed enough to initiate sand transport once again and expose the bone.

The Finley site bison were tentatively identified as *Bison occidentalis* (Schultz and Frankforter 1951). The latest bone recovery at the Finley site yielded a single cranium intact enough to provide some comparative data. According to Wilson (1974a) the specimen does resemble *B. bison occidentalis* in some respects but the wide posterior cranial breadth measurements and the robust horn core base argue for a *B. bison antiquus* designation. The specimen in question was a mature male. Other cranial fragments were found but none were complete enough for species identification.

Partial mandibles and individual teeth recovered represent at least 58 right and 48 left mandibles. Using the methods of determining the age of bison cited by Frison and Reher (1970) in conjunction with population dynamics of large samples from kill sites (Frison *et al.* 1976; Reher 1970, 1973, 1974b) we can make several assumptions concerning the seasonality of the Finley site bison kill. The mandibles fall into discrete age groups 1 year apart. The first five age groups were determined by tooth eruption and wear. Age group 1 includes three animals approximately .8 year (9.6 months) of age. Age group 2 includes a single animal 1.8 years of age. Age group 3 includes eight animals 2.8 years of age. Age groups 4 and 5 each include seven animals 3.8 and 4.8 years of age. Older age groups are beyond maturity and age was determined by tooth wear alone. Because the mandibles are fragmented and have very few teeth in place, close determination of age groups beyond maturity is difficult. As a result we are somewhat unsure of the age structure of the entire bison sample but we can define at least 11 and possibly 12 discrete age groups.

The present-day peak of bison calving is about the middle of April. Animals in age groups of .8 years, 1.8 years, 2.8 years, and so on should therefore represent a midwinter kill—probably several small kills within a short period of time rather than a single mass killing. The fragmentary nature of the mandibles did not allow meaningful sex determination from mandible size (see Reher 1970, 1973, 1974b). Sex determination on the basis of metatarsal and metacarpal measurements of mature animals seems to have validity and suggests a herd composition of 73% males and 27% females (Bedord 1974:234). Volume measurements on astragali also suggest a high percentage

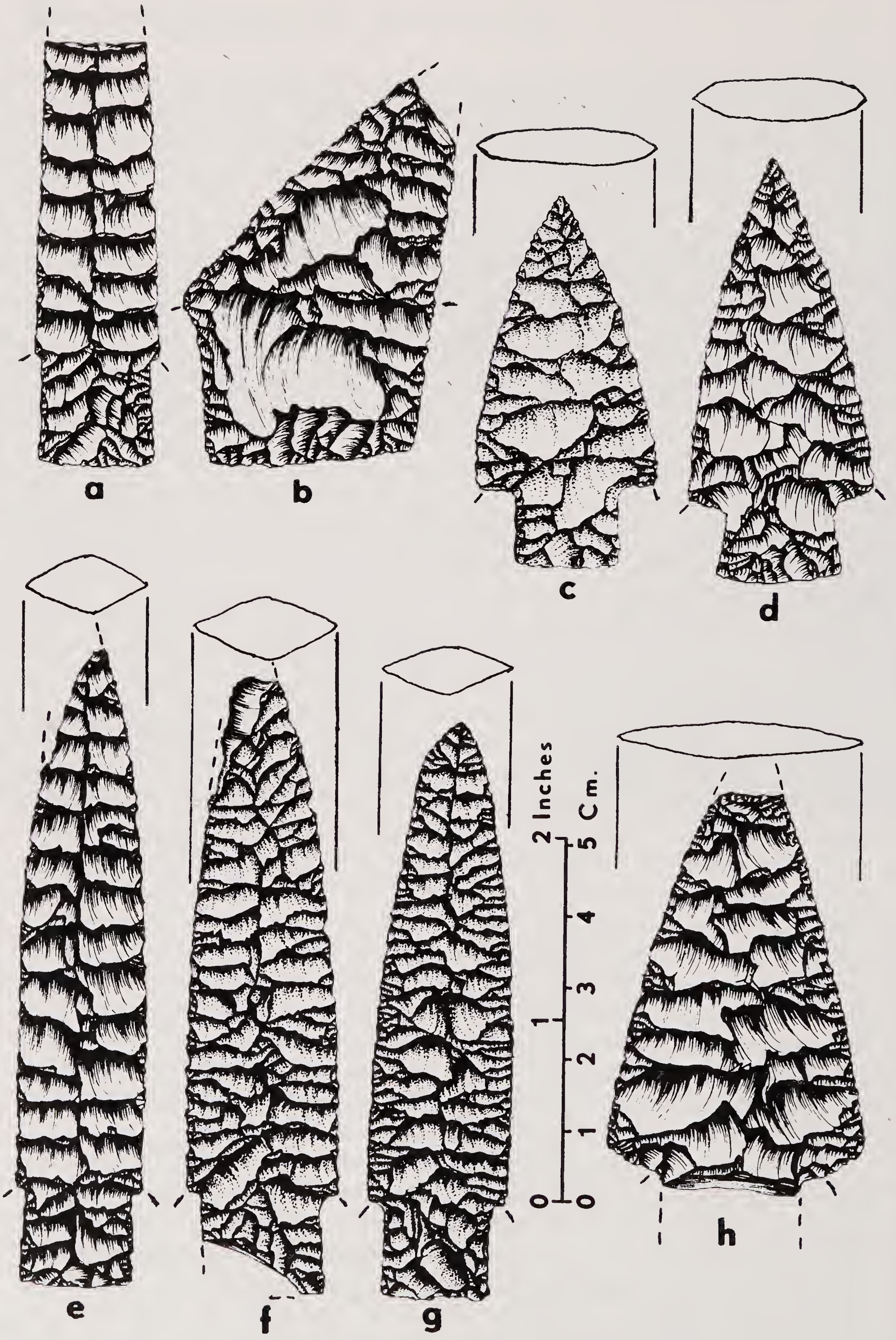


FIGURE 5.23. Projectile points (a, e–h) and knife (b) from the Finley site, and Scottsbluff points (c, d) from the Larson Cache.

of males (Zeimens and Zeimens 1974). This is in strong contrast to the Casper site, where the proportion of males was 11%. This strongly suggests that the hunters at the Finley site were successfully trapping and killing many groups of males but only a few nursery herd groups. Groups of mature males rarely number over a dozen animals. In midwinter we would expect mature males to forage apart from the nursery herds, and the handling of the two groups would have been quite different. On the other hand, there is no reason the same trap should not have been effective for trapping both kinds of herds.

It appears very likely that the Finley site was a sand dune trap similar to the Casper site. The sand dune area in the vicinity of the Finley site contains occasional parabolic dunes like those in the Casper site area. There are no trees anywhere near the site area except for recent artificial planting, nor are there indications that trees were present in Holocene times, so there would have been no materials with which to construct a corral or pound. Today big sagebrush and bunch grass anchor the sand dunes, and greasewood grows on nearby alkaline flats. None of these can be regarded as suitable material for bison pound construction. It is tempting to suggest that animals might have been stampeded into the spring and bog area to the west of the site and killed before they could get out. On the other hand, animals killed in the bog would have been extremely difficult to butcher and remove from the bog. In addition, the contents of bogs do not enhance the meat products and it is almost impossible to do anything with a dead animal in a bog without getting the objectionable materials on and inside the entire carcass. The spring and the bog probably attracted the animals, since in winter grazing animals much prefer drinking warm spring water to eating snow. The hunters were very likely intercepting small groups of bison after they had drunk their fill, since they would have been easier to manage.

A large part of the artifact material from the Finley site was recovered by O. M. Finley and still remains in the possession of the Finley family. O. Fred Finley made this material available for study. The projectile points are rather small and delicate compared to those from the Horner site but otherwise are similar technologically. Several of the specimens demonstrate impact fractures similar to those found on projectile points in other bison kills. All were manufactured from raw materials available locally in the Green River Basin. There are, however, two distinct types or variants of projectile points. One, the Eden type, is long and lanceolate with a straight or slightly expanding stem and a diamond-shaped or lenticular transverse cross-section (Figure 5.23a, e–g). The other, the Scottsbluff type, is a wide, thin, stemmed point, triangular in outline (Figure 5.23h). One Cody knife (Figure 5.23b) was recovered, along with a few small tool-sharpening flakes—but these tools are not enough to be commensurate with the amount of butchering that we think occurred. One of the projectile points demonstrates reworking and wear, probably from use as a tool. It should be remembered that the original Finley lithic collection was recovered from the original site location and we are lacking most of the artifact material of the recently discovered kill area. No butchering analysis was attempted because of the disturbed nature of the bone deposits.

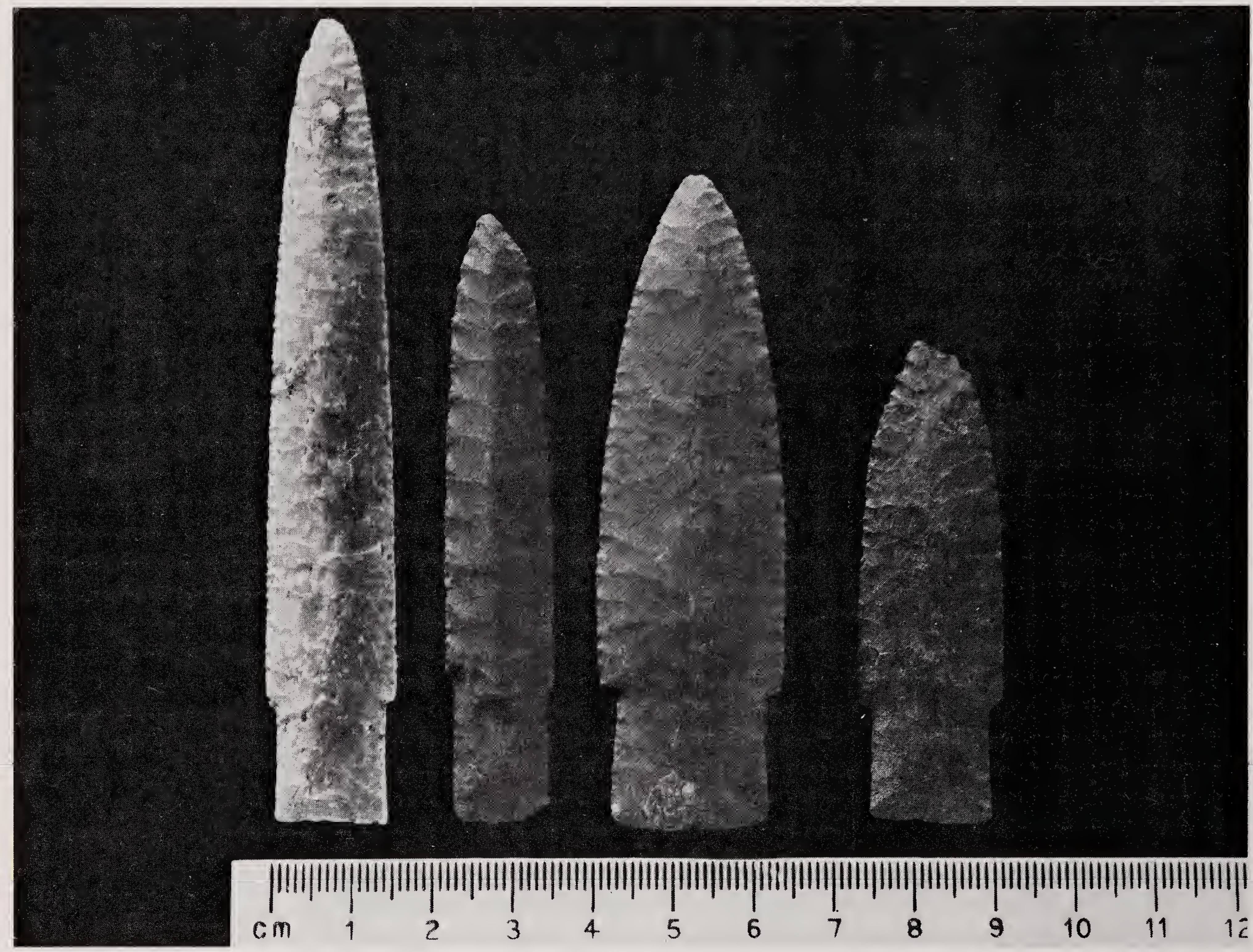


FIGURE 5.24. Projectile points from the Carter–Kerr McGee bison kill site.

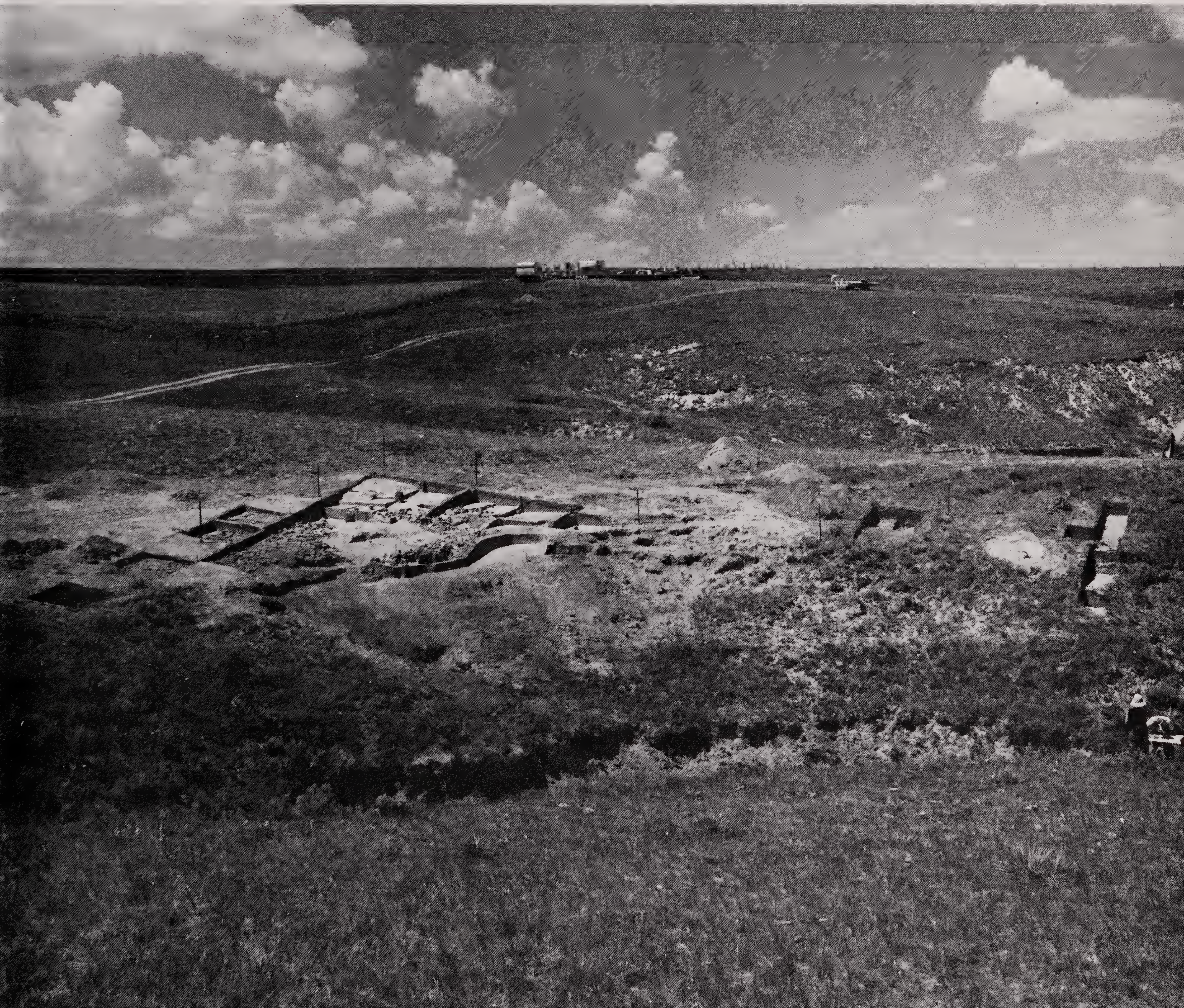
In summary, the Finley site was a sand dune bison trap of the Cody Complex and probably resembled the Casper site sand dune bison trap. The bison, consisting mostly of males, numbered at least 58 and were killed in midwinter. The projectile points seem relatively small and may have been used as dart points rather than as thrusting spears. Two different point variants were present. The bison involved seem to have been *B. bison antiquus* with some *B. bison occidentalis* characteristics.

Other Later Paleo-Indian Bison Kills

An arroyo bison kill of the Cody Complex was discovered near Gillette, Wyoming. Projectile points (Figure 5.24) are of the Eden and Scottsbluff type. The site is located at the head of an old arroyo (Figure 5.25) and was nearly destroyed by an earlier cycle of headward erosion. The present cycle of gullying has created an ideal natural bison trap directly below the site location and is probably very much like the one used during Cody Complex times.

Several miles south of the Finley site, the active sand dune areas of the Killpecker dune field have been favored locations for collections of Paleo-Indian artifacts. In the spring of 1964 Robert and Jo Larson of Rock Springs, Wyoming, discovered what is believed to be a cache of Scottsbluff-type projectile points uncovered by wind at the edge of an active dune. Later in 1964 and in 1965, several other specimens were recovered, a total of 42 separate

FIGURE 5.25. Excavations at the Carter–Kerr McGee bison kill site. Note the headward erosion of the present arroyo forming an ideal bison trap. The exposed bone bed is of the Cody Complex. Underlying this are Hell Gap, Agate Basin, and Folsom levels.



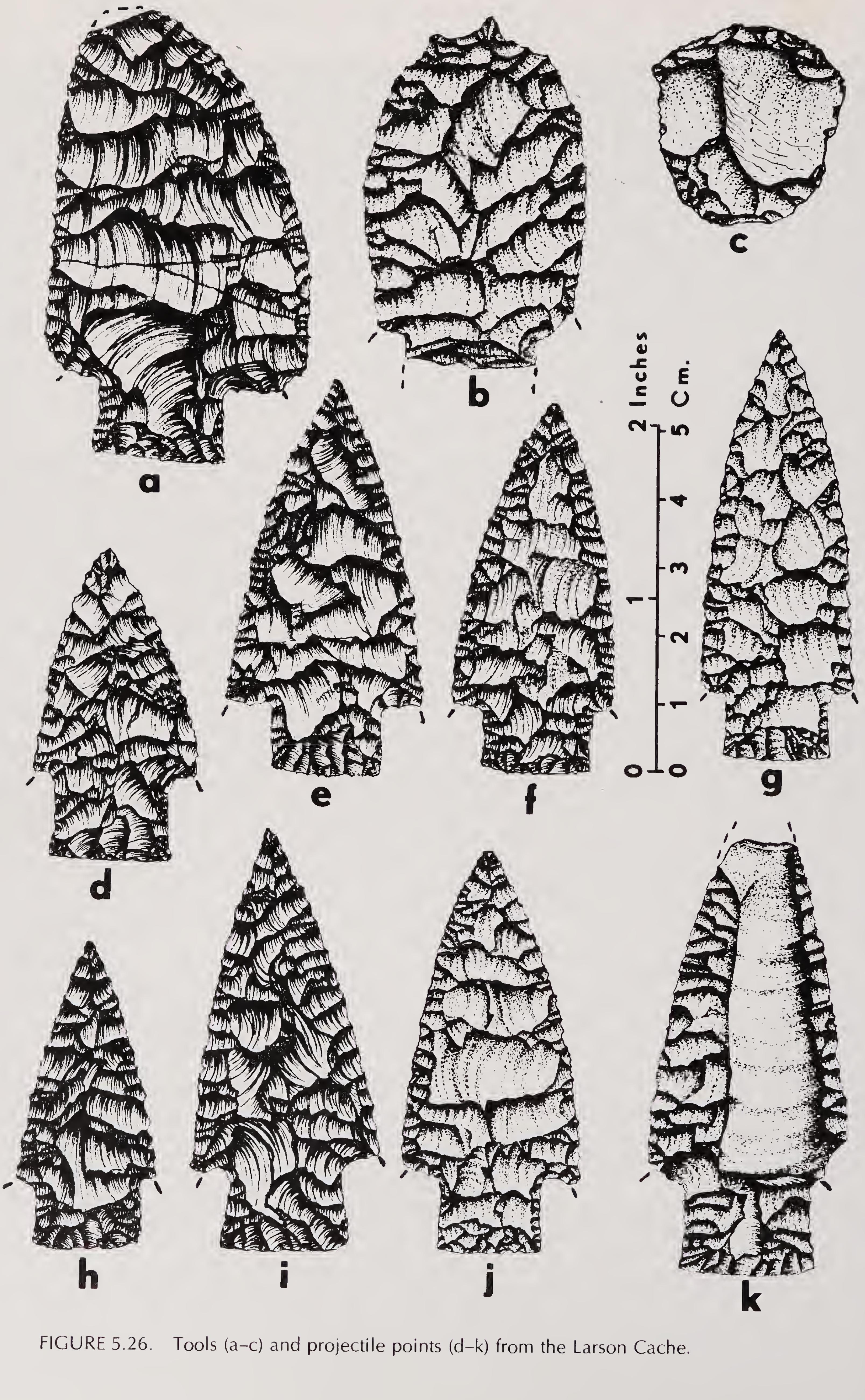


FIGURE 5.26. Tools (a–c) and projectile points (d–k) from the Larson Cache.

specimens including three tools, a spurred end-scraper (Figure 5.26c), a Cody knife (Figure 5.26a), and a double-pointer graver-like specimen (Figure 5.26b). The area is now covered with sand and may not be exposed again for some time. Unfortunately, material for radiocarbon dating was not present. Scattered bison bone suggests a possible kill site.

The projectile points can only be classified as Scottsbluff type and appear to have been made by a single flint knapper. Some appear to have been reworked (Figure 5.26d, h) whereas others were not (Figure 5.23c, d; Figure 5.26e–g, i, j; see also Chapter 2, Figure 2.4d). One (Figure 5.26k) has an unusually long impact scar on one face. This represents the largest known single sample of this type of Paleo-Indian projectile point.

The James Allen site near Laramie, Wyoming, was a bison procurement site in an area of almost no topographic relief today. The investigator (Mulloy 1959) suggested that it was a butchering site and mentioned the possibility of an enclosure but no evidence of an enclosure has been found. Dated at about 7900 years ago, it is among the latest known Paleo-Indian bison procurement sites; unfortunately little can be said about the actual methods of obtaining the animals.

The student of Paleo-Indian and Early Plains Archaic bison kills should be familiar with a number of other sites throughout the Plains and adjacent areas other than those already mentioned. These include the Wasden site (Butler 1968, 1971), the Fletcher site (Forbis 1968), the Plainview site (Sellards *et al.* 1947), the Cherokee Sewer site (Shutler *et al.* 1974), the Simonsen site (Agogino and Frankforter 1960), the Rex Rodgers site (Speer 1975), the Scottsbluff Bison Quarry (Barbour and Schultz 1932; Schultz and Eiseley 1935), and the Itasca site (Shay 1971).

THE ALTITHERMAL OR EARLY PLAINS ARCHAIC PERIOD

I have already mentioned that the Altithermal period cultures on the Northwestern Plains are only now becoming better known. Most of what we do know comes from areas in and close to the mountains, and evidence of bison there has been limited to an occasional specimen. For evidence of bison procurement during this time period, it is necessary to go about 100 miles east of the Bighorn Mountains to the Black Hills.

The Black Hills are an uplift about 100 miles long and about half that distance wide. The highest point in the Black Hills is over 7000 feet and is in South Dakota. Most of the Black Hills are in South Dakota, with about 40% in Wyoming. They are quite heavily timbered with ponderosa pine, quaking aspen, and a hybrid species of oak. This vegetation contrasts sharply with the flora of the other mountain ranges and the surrounding sagebrush and grass plains. Within the Black Hills, however, there are numerous small stream valleys and other areas of open, grass-covered country that are quite different from the timber-and-brush-covered hills. The Black Hills also enjoy slightly more yearly precipitation than the surrounding plains and their grass cover is somewhat superior. The Black Hills must have presented optimum conditions for the propagation of the bison herds in the past. The grass is lush and the area is well watered with several small but permanent streams flowing from the hills. Good winter protection is offered by brush-and-timber-covered stream and arroyo valleys, and good browse is available during deep snow periods.

Neither the Wyoming nor the South Dakota Black Hills have experienced more than preliminary archeological investigations. One possible exception is a strip of relatively open country beginning west of Sundance, Wyoming, and extending east to the South Dakota line, a distance of about 25 miles. This strip of country lies between the Bear Lodge Mountains and the Moskee area and is relatively open, well-watered country with good grass. The geological formation present is the Jurassic age red beds. The red shales of this formation are easily eroded, as are the derived sandy soils. Although the topsoil is held in place by a heavy root growth, the drainage pattern on valley slopes is one of deep, narrow, steep-sided arroyos. This formation is characterized by thick beds of gypsum, which is easily eroded and water soluble. This has resulted in many sinkholes or a karstlike topography in the areas where the gypsum is exposed.

All these geomorphic features have figured prominently in the utilization of the area by bison hunters for at least the last 6500 years and probably longer. Several years of archeological survey, testing, and excavation have been done in an area of about a square mile centered about 7 miles south of Sundance, Wyoming. Triassic red sandstones form a scarp about 50 feet high above an area of low, rolling hills and shallow meandering arroyos. Toward the base of the scarp, the slopes increase in gradient for a distance of a quarter-mile or so and soils derived from the erosion of the sandstones are quite deep and easily eroded. Arroyos here are narrow and deep with steep banks, and as they extend into areas of lower relief and their gradients decrease, they become wider with flat, grass-covered bottoms and low banks. For several thousand years they provided ideal avenues up which bison were driven until the sides of the arroyo became high enough and steep enough so that the animals could not get out. Knickpoints (Schumm and Hadley 1957) or perpendicular walls several feet high across the bottoms of arroyos are common erosional features in ephemeral streams, and as mentioned earlier in the context of the Agate Basin site many of these form ideal natural traps. We have evidence for this kind of activity in the area just described during the early Altithermal period from about 6000 to 6500 years ago, as well as for more intense bison utilization in subsequent periods.

The Hawken Site

The Hawken site is located on a ranch of the same name in the area just mentioned south of Sundance, Wyoming. The site is an arroyo bison trap discovered by artifact hunters who noticed bison bone and projectile points eroding out of a perpendicular cut bank. I learned of the site in 1971 and on the basis of an examination of several fragmentary projectile points concluded it was probably nothing more than another Late Archaic bison kill site. However, upon closer examination of the site and the bison cranial material that had been recovered, I realized that several of the horn cores could not have been from modern bison. About half the site was still intact and arrangements with the Hawken family, the landowners, were made to protect the remaining part of the site, which was then excavated in 1972 (see Frison *et al.* 1976).

The Hawken site is a classic example of the arroyo trap where the animals were driven up the bottom of an arroyo by the hunters until a knickpoint barrier was reached (Figure 5.27). Some hunters followed the animals up the bottom and along both sides and others were strategically stationed to ensure that the animals did not take a wrong fork of the arroyo. Pursuit was undoubtedly quite intense to prevent the lead animals from turning around and causing the entire herd to follow suit and stampede in the opposite direction. If the herd did turn it would have been very unlikely for any number of persons to stop it; the only course of action then would have been to let the herd go and hope that it would not travel too far and would calm down enough for another try. Perhaps a better decision yet would have been to find another herd.

The suggestion has been made by some who are unfamiliar with handling bison that the Hawken site was a situation in which a bison herd was stampeded over the edge into a deep, narrow arroyo in a manner analogous to that at the Olsen–Chubbuck site. Although the idea may have merit at first glance, careful consideration of the site and its surroundings along with the way bison behave in given situations strongly rules out the latter kind of procurement situation. A stampede to a jump-off point requires a large herd of animals and the proper kind of terrain to get the herd moving and keep it moving until the jump-off is reached. The arroyo drainage pattern at the Hawken site, which geological evidence leads us to believe has not altered significantly from the time of the Hawken site operation, simply would not have allowed the proper manipulation of a bison herd. The arroyo trap with the animals driven up the bottom to a knickpoint barrier with steep side walls is the more acceptable alternative.

There were at least three separate periods of use at the Hawken site but the time lapse between these periods is not known. The lapses of time are apparent by the several inches of soil between the three bone levels. However, the frenzied activity of even a small herd of bison in a confined area as they attempted to climb the steep but soft walls of the arroyo and milled around in the trap itself could easily have resulted in the accumulation of several inches of soil over the bones from a previous kill. It is possible that the three levels at the site represent three kills in a single season or kills over a period of years. The time of year of the Hawken site operation was probably early winter or mid-winter. A large sample of bison mandibles and cheek teeth were used to determine the season of the kill. In this case I performed a population analysis

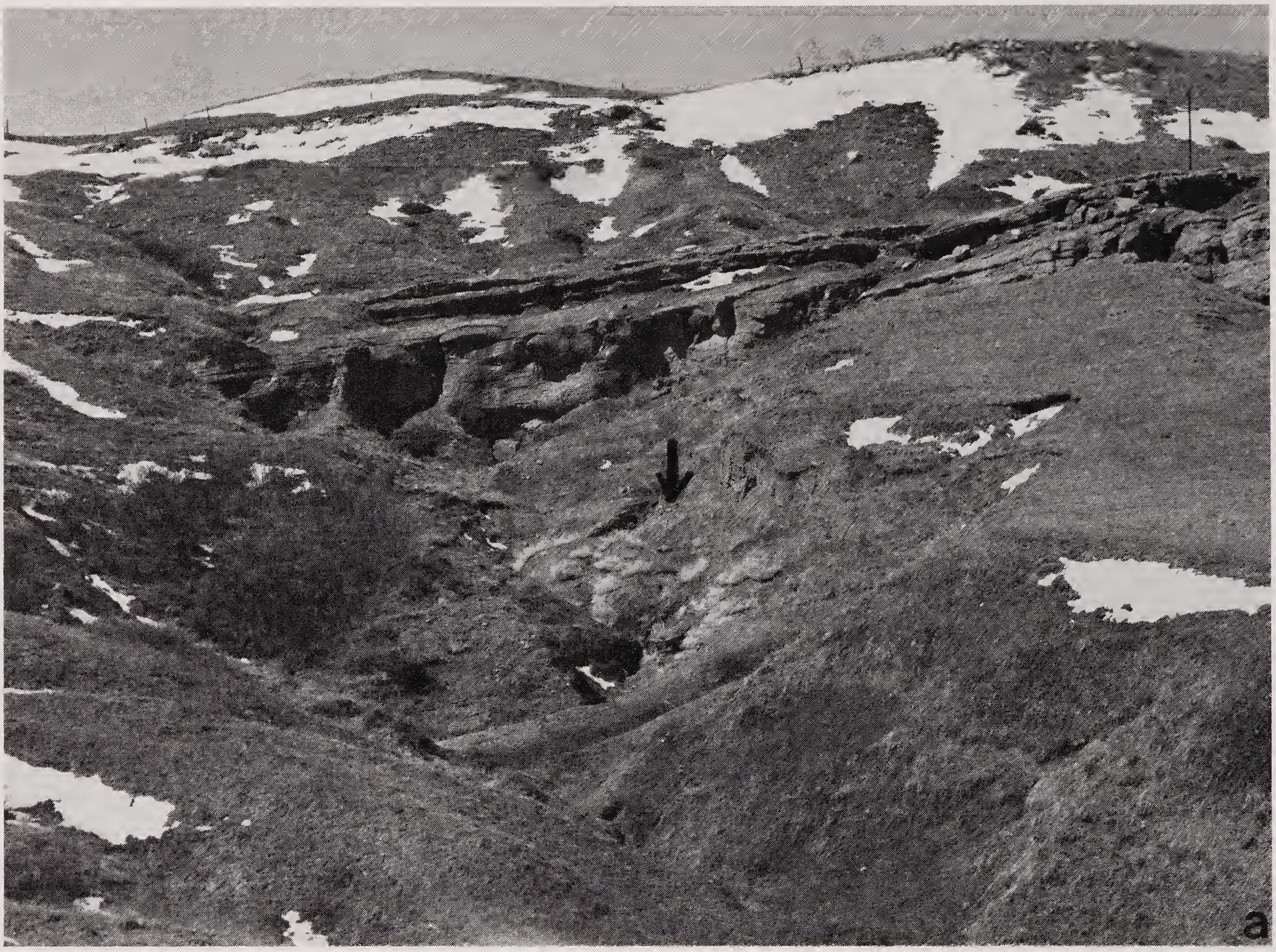


FIGURE 5.27. Hawken site area (a) and excavations in the old arroyo (b) at the site.

using the lower teeth and another investigator (Michael Wilson) performed a population study based on the upper teeth. The results correlated very closely and add a strong measure of credence to the methodology used (Frison *et al.* 1976).

A large sample of mature male skulls at the Hawken site indicates that the hunters were taking mature male groups of animals as well as nursery herd groups. The Hawken site bison are larger than the modern form (Figure 5.28) but smaller than those from the Casper site. They are believed to represent the northern chronosubspecies or *B. bison occidentalis* and are characterized by a more posteriad deflection of horn core, greater orbital width, and less cranial breadth than the skulls of the southern subspecies. The Hawken site strengthens the contention that there has been a steady dwarfing of the species during the Holocene. The measurements on metatarsals and metacarpals (Bedord 1974) and on volumes of astragali (Zeimens and Zeimens 1974) provide further evidence of the intermediate size of the Hawken site bison population dated at around 6400 years ago. A more recent discovery of similar bison in the same general area which were dated at 6000 years ago further strengthens the argument.

The measurable skulls at the Hawken site were all males, though metacarpal and metatarsal measurements (Bedord 1974:234) argue for only a slight preponderance of males in the total sample of mature animals (at least 61 animals). This number is based on lower teeth. The total number of complete metatarsals and metacarpals with fused distal ends (attesting to animals 4 years of age and above) number 23 and 27 respectively. This is the sample used in sex determinations but not the entire sample since many were incomplete. It is, however, regarded as a valid population sample. Some of the mandibles and

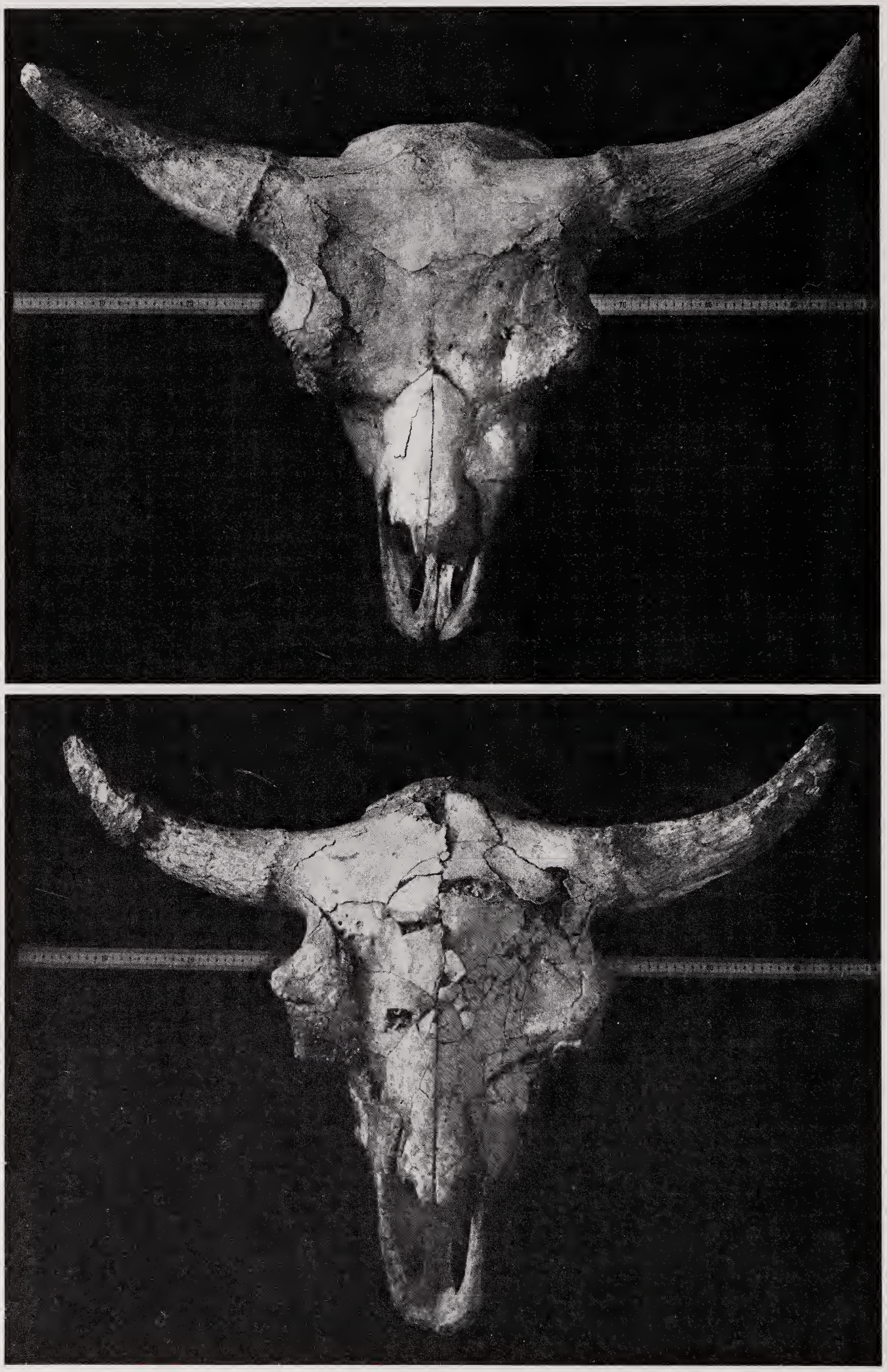


FIGURE 5.28. Male bison skulls from the Hawken site.

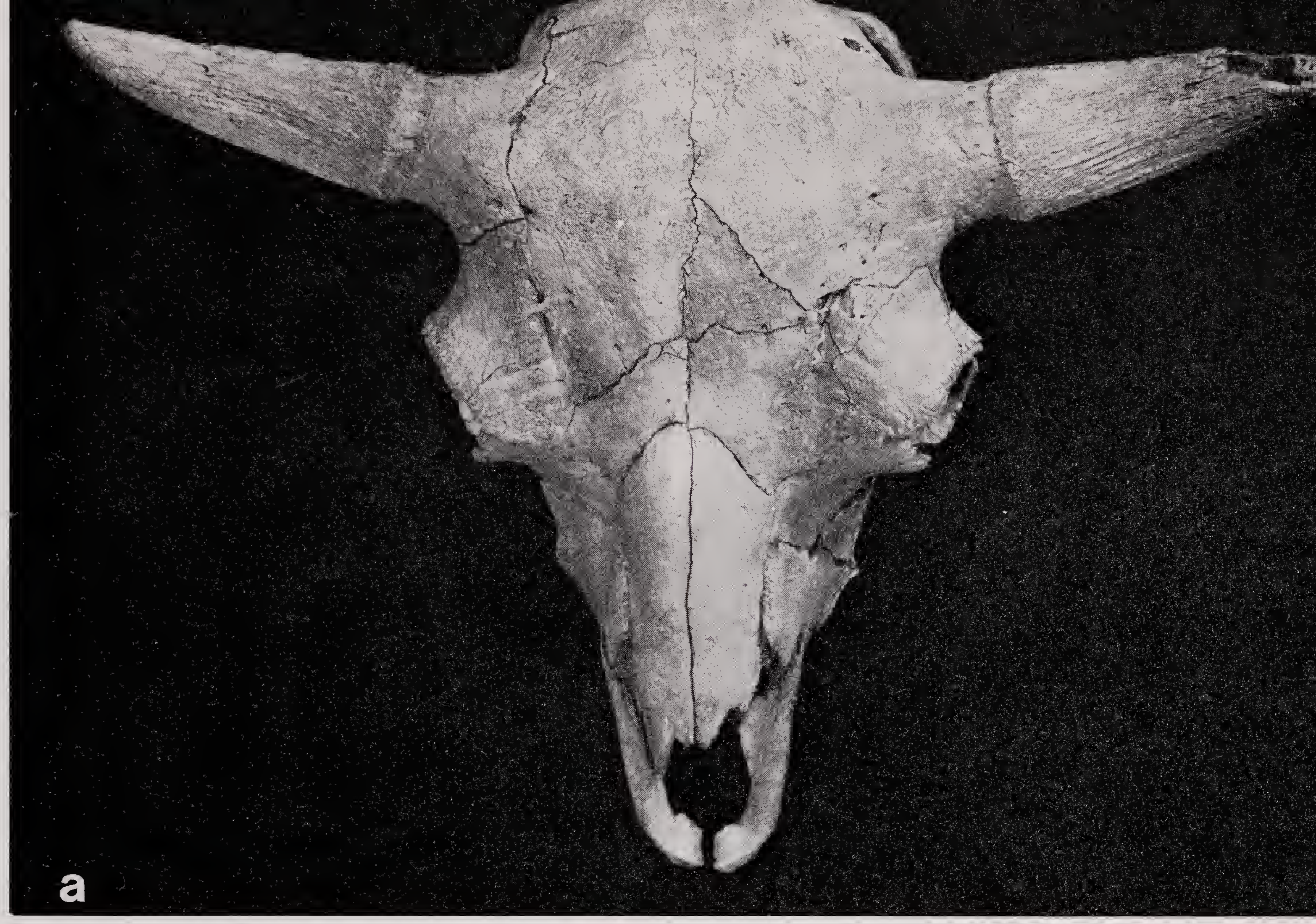
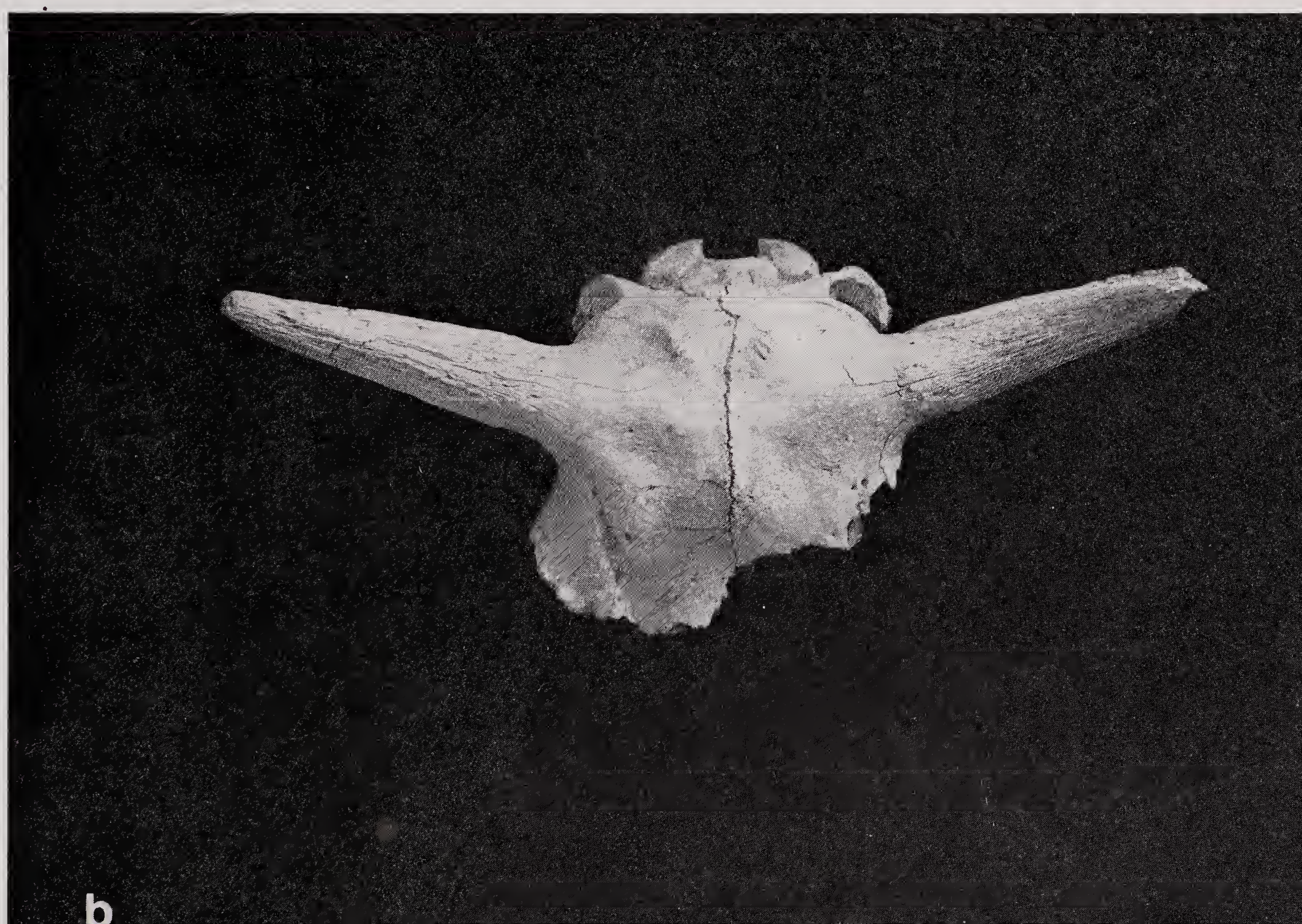


FIGURE 5.29. Male (a) and female (b) bison skulls from the Hawken III site.



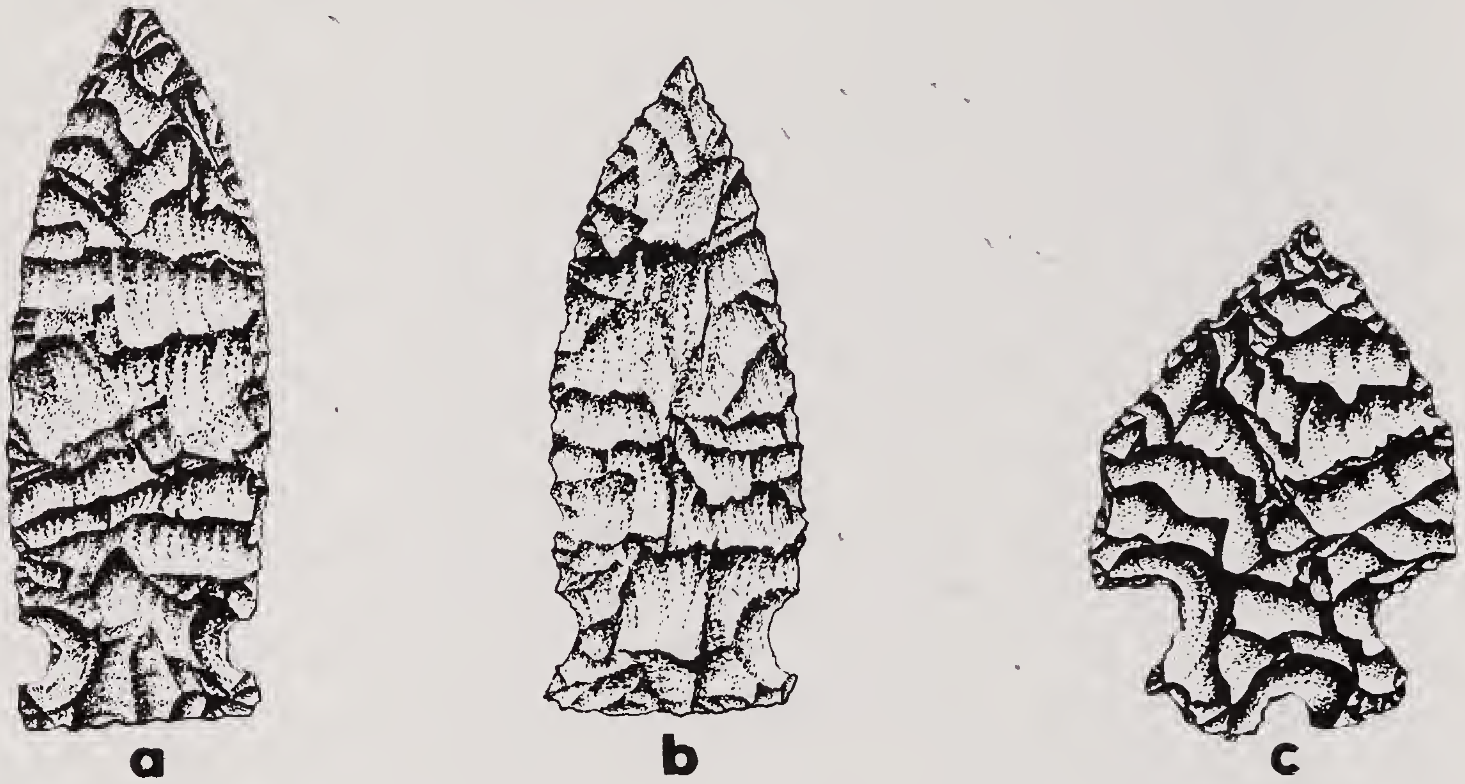
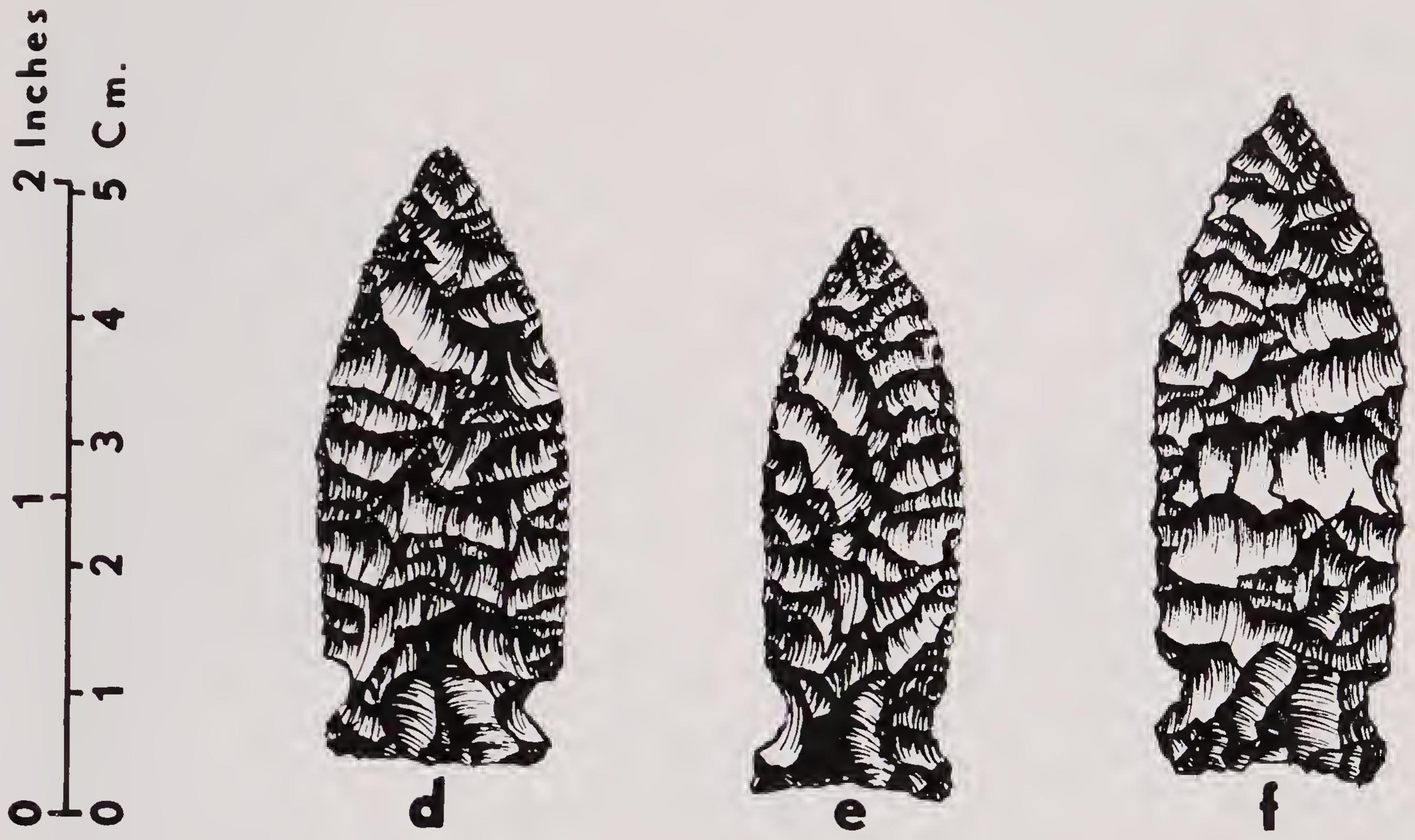


FIGURE 5.30. Projectile points from the Hawken (a, b, d–f) and Laddie Creek (c) sites.

upper teeth are believed to be from females, but the lack of female cranial parts appears to have been due to their deliberate removal from the site by the hunters. Consequently no female crania can be described from the Hawken site.

In the spring of 1975, a similar concentration of bone was discovered eroding out of an arroyo bank close to the Hawken site. Excavations in the spring and summer of 1975 revealed a pile of nine bison skulls along with several other postcranial bones. Butchering evidence was present (a stacked pile of bones); the actual kill site may be nearby or it may have been removed by arroyo cutting. This site (Hawken III) is dated at 6010 B.P. ± 170 (RL–484) or about 300 to 400 years later than the original Hawken site. Preliminary measurement of the Hawkin III male crania (Figure 5.29a) indicates a close similarity to those from Hawken. Three partial female crania were recovered from the pile of nine from Hawken III. The latter (Figure 5.29b) have long, slender horn cores that extend laterally and are quite different from those of modern female bison (see Chapter 7, Figure 7.3b). The Hawken III operation probably took place very close to calving time; mandibles from two calves are almost exactly 1 year old and part of a fall-term fetus was present in the bone pile. This strongly suggests a kill between mid-March and early April. A closer determination might be possible with a larger mandible sample.

The Hawken site bison mandibles are easily separated into yearly age groups. The population structure of the site, like that of the Casper site, suggests that most of the bison lived to an age of about 12 years although an occasional animal might live longer. However, the tooth anomalies that were observed at the Casper site were not present at Hawken. Postcranial pathologies were infrequent also and those noted could have resulted from normal mishaps and from male dominance displays.



In the procurement operation, the bison at the Hawken site were driven up the arroyo to a location where further forward progress was blocked. The animals were killed at this location and the accumulation of bone caught soil and debris and subsequently forced a change in course of the arroyo. Later downcutting left part of the old arroyo containing the bison kill intact but several feet above the level of the present arroyo, and colluvium covered the bone deposits up to a depth of about 14 feet. A total of nearly 300 known projectile points has been recovered from the site; many more were collected by amateurs but have not been located. The ratio of projectile points to animals is high, which further suggests a trapping situation. In a jumping operation a good share of the animals are killed by the fall itself and by other animals falling on the ones already at the bottom of the jump. A certain amount of killing and maiming occurs among animals crowded into the confines of a pound or trap but most of the killing has to be done by the hunters—with spears, darts, or arrow points, depending upon the time period involved. The projectile points at the Hawken site are the earliest side-notched type known from the Northwestern Plains associated with a bison kill (Figure 5.30a, b, d–f). The use of notches to bind a projectile point to a wooden shaft, was an innovation that spread rapidly over a wide area of the Plains and adjacent areas. Its sources are hypothetical but the Hawken projectile points might be considered as nothing more than terminal Paleo-Indian types such as Fredrick or Lusk with side-notches added. On the other hand the Hawken points are quite similar to projectile points known as Logan Creek in eastern Nebraska (Kivett 1962) and possibly also to those at the Simonsen site (Agogino and Frankforter 1960). If the latter case is true the early side-notched points on the Plains may have relationships elsewhere, instead of being simply a local innovation derived from the terminal Paleo-Indians. Resolution of the problem is not expected

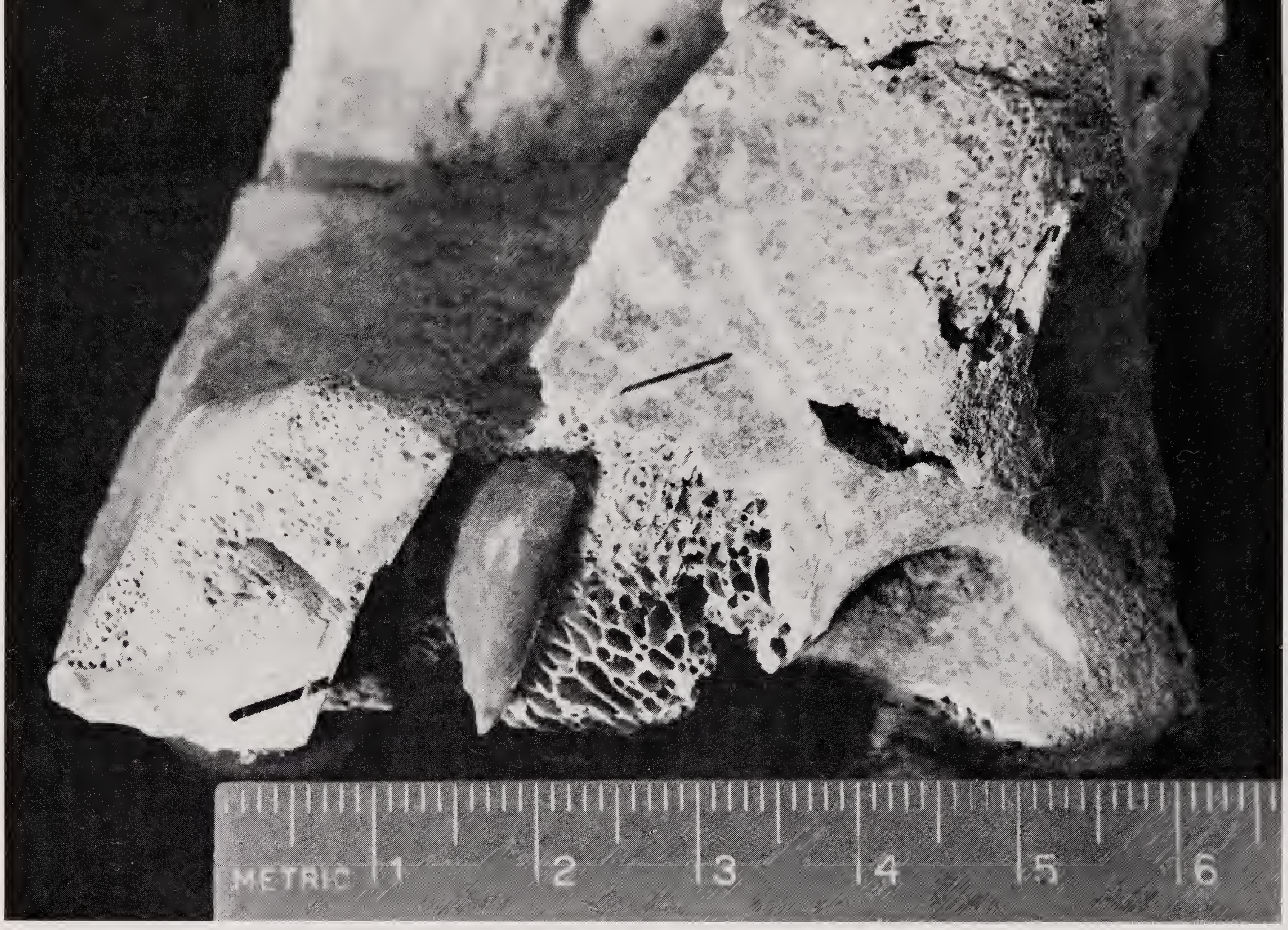


FIGURE 5.31. Tip of projectile point embedded in the atlas of a calf from the Hawken site.

until sites are found that will satisfactorily demonstrate the necessary cultural relationships.

Many Hawken site projectile points demonstrate the results of heavy impact. As in Paleo-Indian sites, all broken points that could be reworked into usable specimens were so treated. It appears that there was actually a single archetype projectile point form with minor variations, and that the seemingly wide variation in the Hawken site projectile point assemblage is the result of modification of broken specimens to restore functional utility. The Hawken site points are unquestionably designed to penetrate buffalo. The notches and bases were ground smooth to withstand thrusting pressure without splitting the shaft or cutting a sinew binding. The tips were brought to a needle-sharp point to penetrate the hide. Evidence of this kind of penetration is demonstrated by the distal end of a projectile point embedded in the atlas of a bison calf. It was undoubtedly a lethal thrust that penetrated deep into the muscles of the neck (Figure 5.31) and on into the bone.

To summarize, up to now only the Hawken site and the Hawken III site have provided evidence of communal bison trapping on the Northwestern Plains during the Altithermal period. The sites are in the Wyoming Black Hills; with systematic investigation of other parts of the area, similar evidence of the same period must certainly appear. The bison killed were of the northern chronosubspecies *B. bison occidentalis* and are intermediate in size between the Casper site animals at 10,000 years ago and modern bison, which were present at least by 2500 B.C.

The kill probably took place in early winter and was accomplished by driving the animals up a steep-sided arroyo until a knickpoint barrier formed a natural trap. Both male and nursery herd groups of animals were killed in the trap. Measurements of the male skulls are published elsewhere (Frison *et al.* 1976). No female cranial elements were found at the Hawken site but both male and female skulls were found in a stacked pile of butchered bones in the Hawken III site and are dated at about 6000 years ago or about 300 to 400 years later than the Hawken site itself. No measurements are as yet published on the latter skulls but preliminary results indicate close similarity in size to those from Hawken.

The bone remained in the kill area after butchering, later caught debris, and forced the arroyo to change its course leaving part of the bone deposits undisturbed. Projectile points used in killing the animals are of the early side-notched type and the cultural affiliations of the hunting group are in question. They could be related somehow to earlier Paleo-Indian groups in the area or to more distant groups. The Hawken site forms a bridge between the late Paleo-Indian bison hunters and those of the Middle Plains Archaic, both of which have provided us with more abundant evidence of communal bison procurement.

THE MIDDLE PLAINS ARCHAIC PERIOD

Although the Altithermal climate remains a largely unsolved problem for the Northwestern Plains and adjacent areas, there seems little doubt that it was not too favorable for the propagation of bison herds, except in possible oasis-like areas such as the Black Hills of Wyoming and South Dakota. We can, however, document a radical climatic change at about 2500 B.C. and at this time bison remains proliferate once more in archeological sites of the McKean Complex. Our data suggest a wider variety of procurement methods. The arroyo trap continued as the most popular method but, aside from a change in the projectile point types present, the traps appear identical to those of the Early Plains Archaic and the Paleo-Indian periods. In addition, bison jumps and corrals are known for this period.

As I indicated earlier in the discussion of cultural chronology there are unsolved problems concerning the projectile points of the McKean Complex. It remains in essence a battle between lumpers and splitters; some interpret the wide range of projectile points found in McKean sites as a range of variation of a single point type, whereas others argue that the complex comprises several discrete types. The data are insufficient to solve the problem and probably will be for some time. It is, however, an important problem for the cultural systematics of the Middle Plains Archaic.

A number of arroyo traps dating from the Middle Plains Archaic have been investigated. The Powder River Basin in northern Wyoming and southern Montana was a favored locale for this type of procurement operation. The basin in question is a large area that includes the drainages of the eastern slopes of the Bighorn Mountains and from there the land to the divide between the Powder and Belle Fourche rivers in Wyoming. The Powder River flows into the Yellowstone River northeast of Miles City, Montana, a distance of about 100 miles from the Wyoming border. A number of Middle Plains Archaic arroyo bison traps are known from along the "breaks" of the Powder River in both Montana and Wyoming. Similar manifestations are also known from other Yellowstone River drainages adjacent to the Powder River.

The Powder River Basin is characterized by nearly flat-lying Tertiary sediments that are moderately to highly dissected by arroyos. Ridges, divides, and hills are rounded by steep erosional faces. The terrain developed as a result of headward arroyo erosion in sediments and the presence in many places of capping beds that are more resistant to erosion than underlying strata. Extremely rough, dissected areas occur along both sides of the Powder River and other major tributary streams. Cottonwoods line the stream valleys, and sagebrush and grass are the dominant flora away from the streams. Poderosa pine is a significant part of the flora toward the northern part of the basin in extreme northern Wyoming and from there to the Yellowstone River in Montana. Large expanses of red scoria hills, believed to be the result of extensive burned-out coal beds of the late Pliocene or early Pleistocene, are prominent geomorphic features of this northern part. Some of these hills rise steeply as much as 100 feet or so.

Arroyo bison traps are usually quite obvious even to the casual observer, and are manifest by thick levels of bone exposed in cut banks. Exposed bones usually fall to the bottom of the arroyo as lateral erosion progresses and they are sometimes scattered for long distances. Large numbers of projectile points make these sites prime targets for collectors; as a result, few sites remain intact. The only limiting factor in site destruction is the amount of overburden, which in some instances is as much as 15 feet. This has saved remnants of at least a few of the sites. Undercutting to follow bone levels in search of projectile points has proven extremely dangerous. At least two near deaths have been recorded from the collapse of undercut banks and this has become a slight deterrent to site destruction.

The first bison kill to be investigated in the area was one in Powder River County, Montana, west of the town of Broadus. Located in an area of moderate relief, the actual kill site was in a short arroyo that branched from a larger one. Headward erosion extended for some distance up a steep slope. The bison were apparently driven up the main arroyo and turned into the branching one and trapped where the head of the arroyo was too steep for the animals to negotiate. The possibility that the hunters used brush or timber fences at the top of the arroyo banks should not be ruled out. Both ponderosa pine and juniper are at present growing in the area and would have provided ample timber for building fences.

The site, known as the Yonkee site after the landowner, has been a favorite spot for digging for artifacts for nearly half a century. As a result its complete story may never be known. A small investigation by the Wyoming Archeological Society (Bentzen 1961) is the only thing approaching a systematic site investigation. The extent of the site and the amount of bison bone and artifacts suggest more than a single operation, although only a single cultural level was recorded. The excavation was done in the days when large bone samples were not collected so that population dynamics and a detailed butchering analysis were not possible. It is quite possible that enough bone remains buried at the site to make a time-of-year determination; a reinvestigation of the site is planned.

The investigators of the Yonkee site noted a tendency for projectile points to be found in rib cages of the bison. Intact rib cages also indicate something of the butchering process, for the butchers were apparently not cutting up or removing the rib cages. Also, a good share of the long bones had not been removed from the site. In fact, large parts of bison carcasses were left intact although there is evidence that muscles had been stripped. Other sites of this same cultural complex appear to bear out these observations and argue for a general butchering procedure of stripping meat from carcasses and leaving the skeletal parts intact.

The projectile points are what could be regarded as a single variant of several within the McKean Complex. They are long and narrow with concave to straight blade edges, side notches, and a basal concavity or in some cases a base notch. Lesser numbers are corner-notched or have straight bases. Most are made of a distinctive local metamorphosed shale that is plentiful, easily worked, and useful for projectile points but is too soft to make good tools. Butchering tools were scarce and no recovery technique was used that would have saved tool sharpening flakes. A radiocarbon date from charcoal is 4450 B.P. ± 125 (I–410).

A single bison skull was recovered from the Yonkee site and this was regarded by the investigator as extremely large. According to the investigator, this was described by C. Bertrand Schultz as an "intermediate form between *Bison bison* and *Bison antiquus* [Bentzen 1961:12]." Efforts need to be made to analyze a larger sample of bone material from the site, since a small collection of postcranial material that I gathered at the site is well within the range of modern bison. The possibility that the one skull collected was actually an unusually large modern male should be pursued.

A small remnant of another bison kill site with projectile points identical to those of the Yonkee site is located on a short, dry tributary of the Powder River in Wyoming (Site 48SH312; Frison 1968c). The site is another arroyo trap and was formed by headward erosion in the Fort Union Formation. The banks of the arroyo at the time of the kill were believed to have been nearly vertical and 15 to 30 feet high. The back of the trap was a perpendicular wall formed in more resistant strata in the Fort Union Formation and was apparently the head of the arroyo at that time (Mann 1968). The trap may have been as much as 100 feet wide but subsequent downward erosion of the arroyo left only a small part of

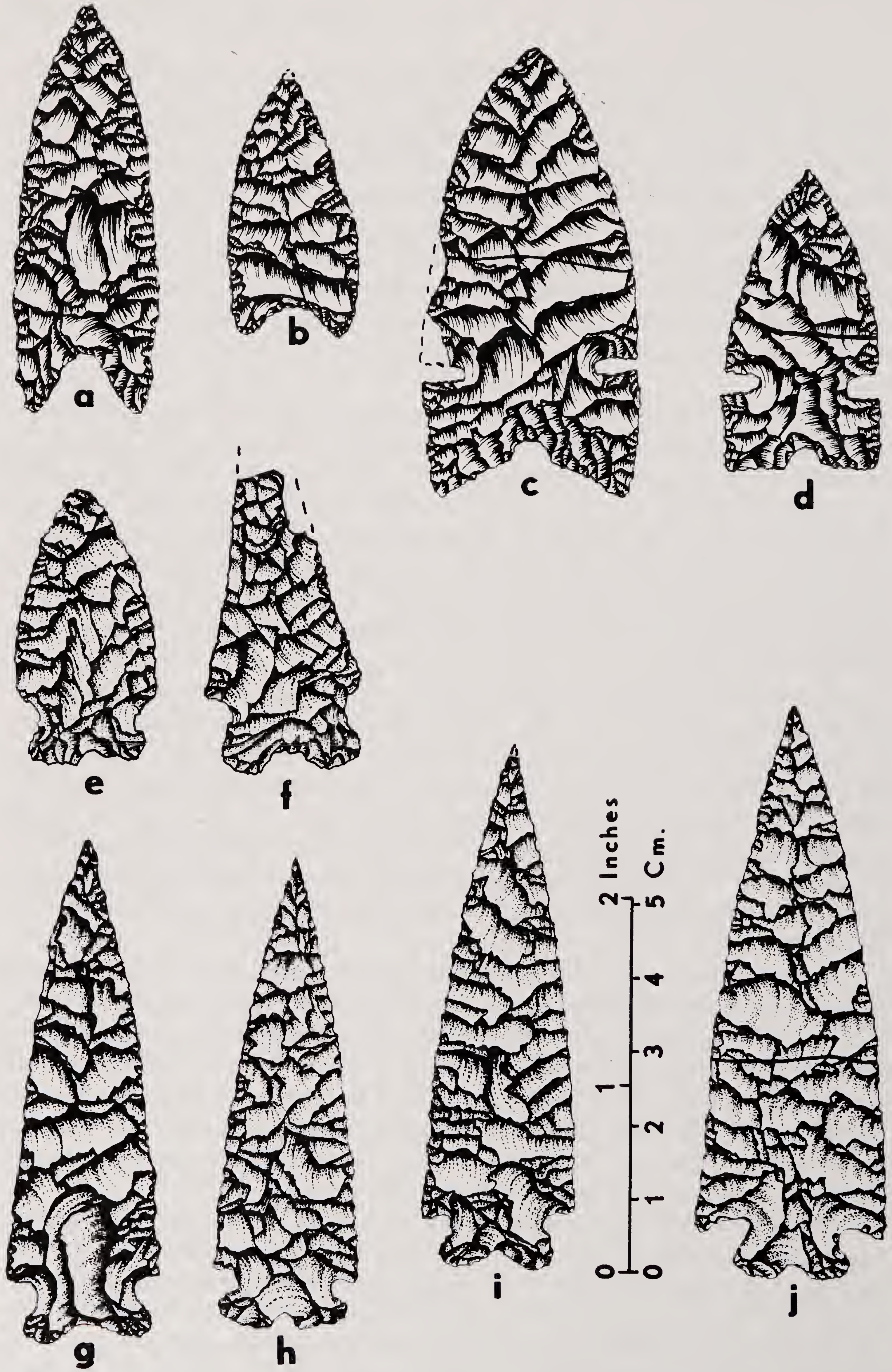
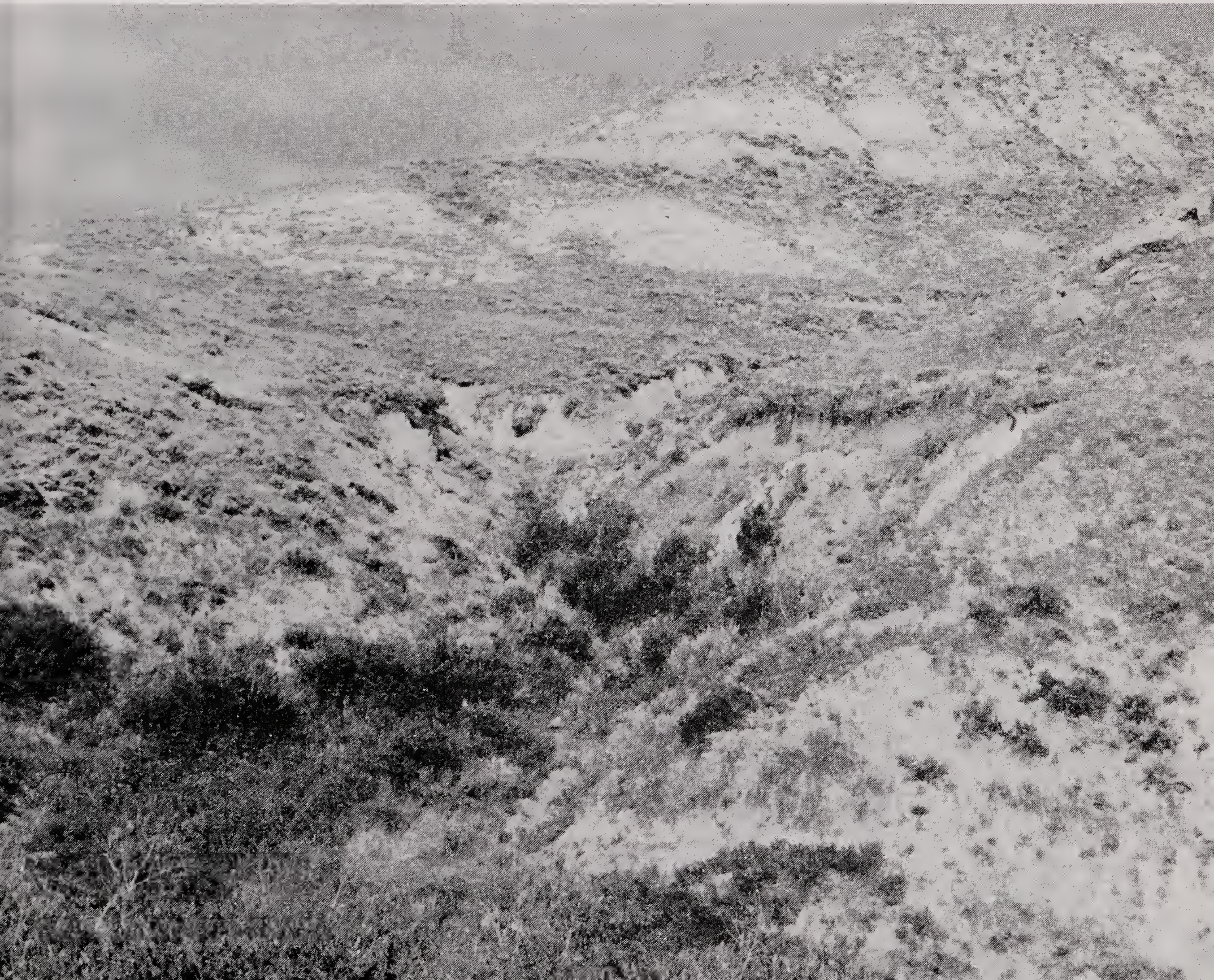


FIGURE 5.32. Projectile points from the Scoggin (a–d), Powder River (e, f, h, i), Mavrakis-Bentzen-Roberts (Buffalo Creek) (g), and Kobold (j) sites.

the trap. Large articulated parts of bison remained and, as at the Yonkee site, projectile points (Figure 5.32e, f, h, i) were commonly found in the rib cages of the animals. A radiocarbon date on charcoal is 2910 B.P. ± 140 (RL–162) and there is no question that the animals were the modern form of bison. The animals were most likely driven up the bottom of the arroyo for some distance from where the walls were not as steep, since the nearby terrain probably made stampeding the animals into the arroyo not very feasible.

A few miles west of Site 48SH312 is yet another arroyo bison kill, 48SH311, in terrain similar to that near the Yonkee site. At 48SH311, animals could have been driven either up or down a wide, flat-bottomed ravine and then turned into the mouth of a short, narrow, steep-walled arroyo that terminated in a perpendicular knickpoint (Figure 5.33). The main ravine has a running spring, which undoubtedly would have attracted the bison if it was present

FIGURE 5.33. The arroyo forming the trap at the Mavrakis–Bentzen–Roberts (Buffalo Creek) site (48SH311).



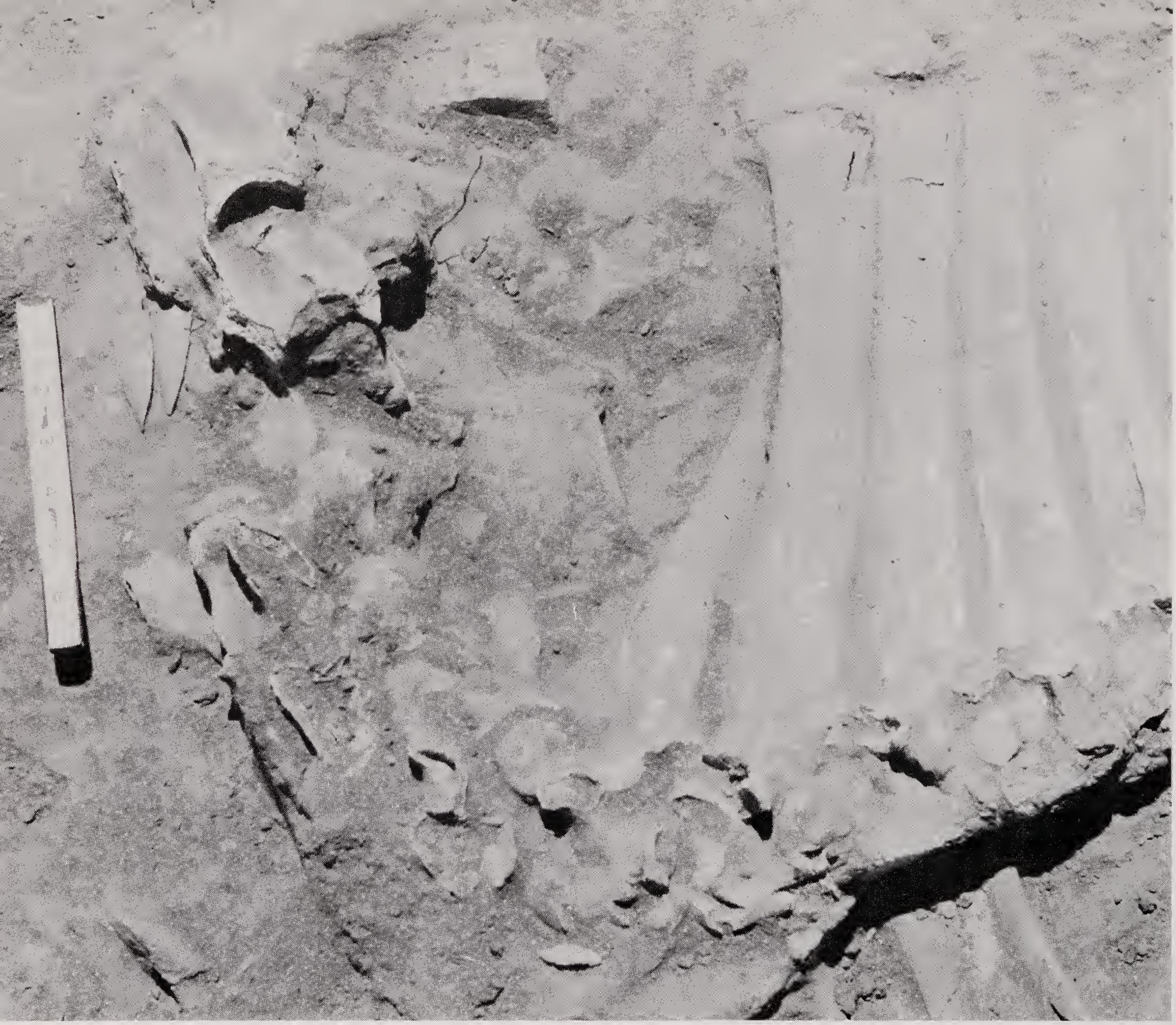


FIGURE 5.34. Projectile points in neck of mature female bison (skull removed for clarity).

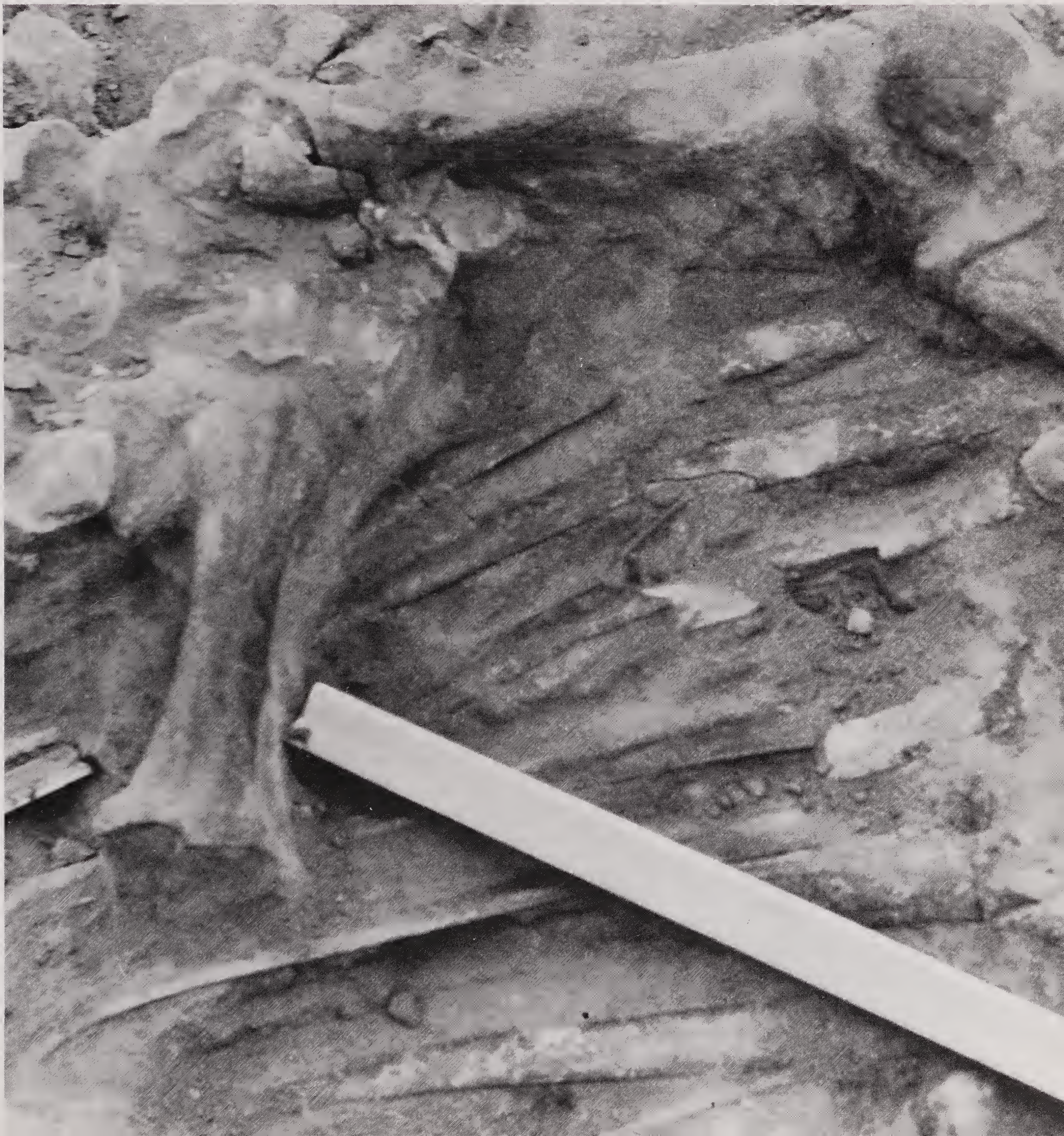
at the time the site was in use. Two separate excavations were made at the site, one by the Wyoming Archeological Society (Bentzen 1962) and a later one by the University of Wyoming in 1972.

In the latter investigation enough mandibles were recovered to determine that the operation took place in early spring, probably close to calving—apparently at about the same time of year as the Agate Basin site operation. There is a suggestion that a small kill occurred much earlier, probably in late fall. The size and extent of the site suggests a number of kills rather than a single one. Two radiocarbon dates are quite close and average about 2500 B.P. Butchering observations were possible at this site (48SH311). It was apparently a muscle-stripping process, in which little or no attention was paid to the marrow of the long bones. Skeletons of entire carcasses were present but thrown together in such a way that they may have been first completely stripped of flesh. There are none of the chopping marks on muscle attachments that are well known and recognized in other bison kill sites, although cutting-tool marks are present. Similar treatment of the carcasses at the Yonkee site and site

48SH312 may suggest that this method of butchering was a trait associated with communal bison kills of this cultural complex.

We were able to recover only a small remnant of Site 48SH311 because of arroyo downcutting, previous excavating, and artifact collecting; fortunately it was a large site. In one area of the site, the bone concentration was light, and in

FIGURE 5.35. Projectile point in bison rib cage.



two discrete locations a cow and calf were found together. It is very likely that the cows were killed and the calves stayed with the mothers. In both cases, projectile points were recovered in the necks of the cows and in the rib cages of the calves. One cow (Figure 5.34) had two projectile points together in the neck whereas only one was in the neck of the other. A single projectile each (Figure 5.35) apparently killed each calf. Other intact rib cages yielded projectile points (Figure 5.32g). All this indicates careful selection of the animal to be killed and then careful placement of the projectile point. It does not indicate a group of hunters on the bank above shooting indiscriminately into a herd of milling animals, a procedure that would not have been at all productive.

Hunters of this same cultural complex were apparently familiar with bison jumping. On Rosebud Creek, a short tributary of the Yellowstone River to the west of the Tongue River in southern Montana, a stratified buffalo jump site was located. This site provided evidence of buffalo jumping as a procurement method used by hunters who were using projectile points identical to those at Yonkee, 48SH311, and 48SH312. The buffalo jumping continued at this site through the Late Plains Archaic and into the Late Prehistoric period. Known as the Kobold site (24BH406), it is ideally situated for jumping bison (Frison 1970b). A sandstone bluff about 25 feet high (Figure 5.36) overlooks a talus slope that terminates further on in a shallow arroyo. This provides an open spot with good access in which to butcher the animals that were driven over the bluff. Back beyond the jump-off are large, well-watered gathering areas that are in one of the better grass areas of the Plains. The terrain provides only one approach to the jump-off, although it may have changed slightly through time, and the position of the bones at the bottom of the jump indicates that the hunters were well able to take advantage of the topography. Drive lines consisting of continuous lines of small stone piles lead to the jump-off, but there is no way as yet to determine whether these date to the older periods of use at the site. Our best guess at this time is that the drive lines are probably Late Prehistoric in age. Drive lines will be considered in depth later, in the context of the Late Prehistoric period bison jumps.

The site was discovered in the late 1950s by persons investigating the historic Crook battle, part of which took place in the small valley overlooking the Kobold bison jump. This battle took place a few days prior to the Custer battle, which occurred a few miles to the northwest on the Little Bighorn River. The Kobold family did some surprisingly systematic excavating at the site and it was through their observations that its value as a stratified site was first realized. The Kobold family diligently protected the site once they realized its scientific value, and they were extremely helpful during the site excavations. In addition, all the materials they collected at the site were made available for analysis.

Butchering at the bottom jump level at the Kobold site follows that of the arroyo traps mentioned earlier. The animals were usually left in large articulated units but occasionally the completely stripped skeleton was left intact as described at Site 48SH311. A good deal more bone breakage occurred but this is believed to be the result of the animals falling over the jump-off since it is different than breakage observed in butchering. Jump-off height was at least 5 to 6 feet more at that time than during its last period of use. The time of year,

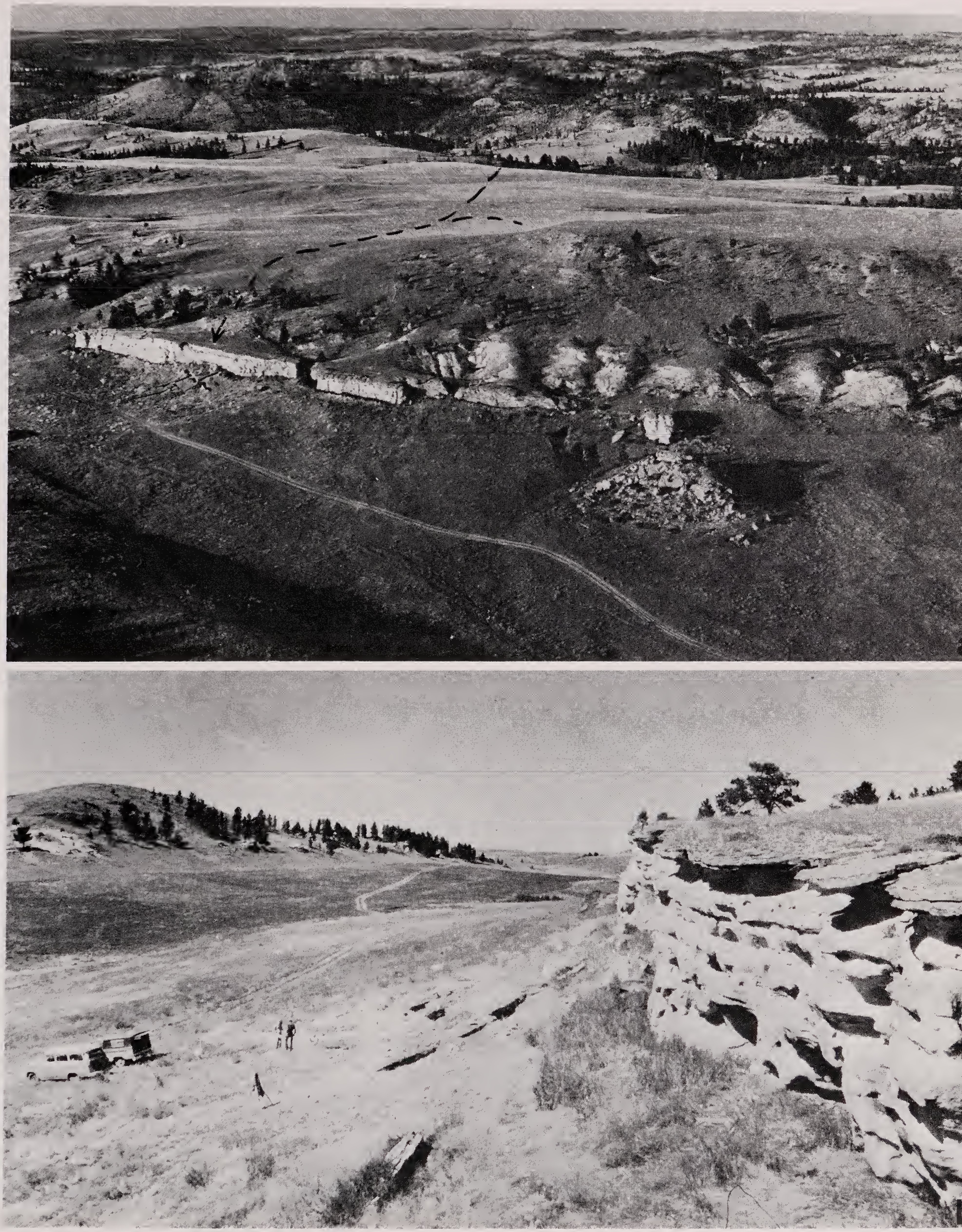


FIGURE 5.36. Aerial view (a) and the jump-off (b) at the Kobold site.

based on a small number of calves, was about late October or early November. There were fewer projectile points per animal than in the arroyo traps, probably because a large number of animals were killed outright or badly maimed by the fall. Possibly after the first few animals piled up at the bottom and were killed, the later ones suffered varying degrees of crippling in the fall and had to be killed. This would account for the projectile points that were recovered.

The projectile points in the bottom jumping level at the Kobold site demonstrate a wider variation of styles than in the arroyo traps described previously for the same time period. Stemmed points reminiscent of Wheeler's (1954b) Duncan type are present, along with true side-notched points as well as those identical to those at Yonkee, 48SH311 and 48SH312 (Figure 5.20j). This wider range of variation might be used to suggest a more secure cultural relationship to the McKean Complex. No radiocarbon dates are available for the Kobold site, but a large part of the site is still intact and a site reevaluation that will include stratigraphic testing for recovery of datable material is planned. Attempts at obsidian dating were made, but there are natural glass sources in the Powder River Basin (see Frison *et al.* 1968) that apparently have different hydration rates than those from the Yellowstone Park sources. Until these hydration rate problems are resolved, the resulting dates will not be reliable.

These four sites in the Powder River Basin—Yonkee, 48SH311, 48SH312, and Kobold—demonstrate a similarity that suggests a strong cultural relationship at least in the economics of bison procurement. Campsites of the complex are as yet largely unknown. This may be the result of geological processes that have preserved kill sites and destroyed campsites associated with them because of different locations and conditions of deposition. In terms of actual bison procurement and utilization, the evidence indicates a strong reliance on fall and winter communal bison procurement. Little is yet known of the economic activities that took place during the remainder of the year. A working hypothesis is that there was some storage of dried meat products for winter use. Present ecological conditions indicate that there were short periods in the winter when weather conditions made food procurement impossible, so some food storage would have been necessary for survival. A communal kill, whether trap or jump, would have provided a quantity of food that could be dried to provide a portable, highly concentrated food supply. The method of butchering, in which muscles were stripped and bone marrow apparently disregarded, along with the relatively small but significant amount of flesh adhering to the bones suggests a single-purpose operation geared to the drying and storing of meat products. I suggest also that these communal kills were conducted also in late winter or early spring when weather conditions permitted.

The bison pound or corral—or a reasonable facsimile of this kind of procurement structure—was in use about 4500 years ago. A site, the Scoggin site (Lobdell 1973) was investigated several miles west of the North Platte River, north of Rawlins, Wyoming. Here bison were apparently driven over a steep talus slope about 20 feet high formed by a thin layer of cap rock over a clay formation (Lobdell 1973). At the base of the slope, postholes connected by low walls of stones rest on a terrace of a dry arroyo. An associated bone level is presently covered by as much as 30 inches of colluvium. Charred wood fragments were recovered from one posthole and long bones had been shoved into holes alongside the posts, presumably to straighten leaning posts. Stones, pieces of wood, and other items similarly placed are still used in livestock corrals to straighten a post that is leaning too far because of pressure from the animals inside. Full details on the size and shape of the corral are lacking, since only a small part of the posthole pattern remained. We think the fence extended for several yards parallel to the base of the slope and then both ends were turned up the slope, to its top. The only means of escape from the enclosure was back up the slope, and the slope itself was not steep enough to hold the animals. One corner of the structure is still present and extra postholes were placed in a way to suggest additional posts providing proper bracing for it. Outside the corral, a feature similar to Late Prehistoric period boiling pits was found. It contained a number of bison bones, among them two male skulls well within the size range of modern bison.

The site location was strategic in terms of normal bison herd movements. It is the end of a natural access gap through a high hogback ridge several miles long. Since the location was on a dry arroyo tributary of the North Platte River, animals would pass by the site area going to and from water. The area is characterized by moderate relief and is not unlike the areas described for bison trapping and jumping in the Powder River Basin. However, grass conditions were somewhat less favorable because of less rainfall. Today both pine and juniper are present, and they were probably there in the past, so there would have been materials for corral construction. In terms of bison procurement, the site operation is completely feasible and the structure was ingeniously constructed. From the sample of mandibles and individual teeth that could be used for age determination, it was found that there were two separate periods of fall procurement involved. Activities could have taken place during the same or different years.

The site contained typical lanceolate McKean projectile points (Figure 5.32a, b) and a wide variety of side-notched styles (Figure 5.32c, d). Two groups of hunters may have been involved. The bone level demonstrates a barely discernible stratigraphic separation into two levels. Few tools were recovered although tool sharpening flakes suggest the use of a number of tools no longer present. The site may be a forerunner of the great number of similar procurement operations known for the Late Prehistoric period. Its greatest advantage is that the short steep slope or the low perpendicular jump-off would have acted as a gate to hold the animals in the pound. The corral structure was probably completely covered with hides or something else to prevent the bison from seeing through to the outside. Even a small hole could have precipitated an attempt on the part of the animals to force an exit, and unless the structure was solidly built, they would certainly have escaped.

Present-Day Analogs of Bison Traps

The archeologist recovers most data from geological contexts and the evidence is interpreted in its context according to the rules of stratigraphy. It is also known and generally accepted that there have been major changes in landforms during the Holocene, especially in areas of high relief and low precipitation such as the Northwestern Plains. We must further accept the fact that the same geological processes that occurred in the past are happening somewhere today.

The geologist can usually study a bone level from a bison kill high in a bank several feet above the present arroyo bottom and provide a reasonably accurate reconstruction of the topography at the time the bones were deposited. It may have once been the bottom of an arroyo with steep, high banks adjacent to a perpendicular knickpoint wall. If the geological interpretation is correct, there should be present-day analogs for these kinds of geomorphic features.

A detailed survey of certain parts of the country reveals many areas suitable for bison traps. I discovered one that is believed to represent the ideal arroyo trap in the bottom of an arroyo a short distance from the Agate Basin site. This arroyo has perpendicular banks about 9 feet high and a flat, grass-covered bottom about 150 feet in length. Its width is about 35 feet, and about 75 feet from the posterior wall the arroyo narrows to form an elongated oval enclosure. About 300 feet from the trap the banks of the arroyo are lower and less steep and the surrounding terrain provides ideal entry for the animals into the bottom. The arroyo also curves slightly so that the animals could not see into the actual trap until they reached a point where the banks were too steep for egress (Figure 5.2). There is no reason why bison could not be successfully driven into this natural trap.

The trap at the Hawken site was eroded out of soft bedded sandstone—in contrast to the one just mentioned, which is in alluvium. The Hawken trap was technically formed not by a knickpoint but by a relatively harder mass of sandstone over which runoff water spilled, eroding the softer sandstone below. An almost identical situation is present in an arroyo close to the Hawken site. In this case, the runoff water carved a path through the harder sandstone, but not one wide enough for a bison to pass through. Directly below the Hawken site, headward erosion has resulted in the formation of an excellent natural trap—only this one is in poorly bedded shale rather than sandstone. The configuration of these natural traps can change rapidly. A single gully-washer or heavy spring runoff can change a good natural trap into a worthless one, and a worthless one into a good one.

Most buffalo jumps are little changed from when they were in use so postulations as to former configurations are unnecessary. Sand dune traps, however, like arroyo traps, can be short-lived. Some present-day dune fields demonstrate areas of sand transport and the dune field adjacent to the Casper site is an excellent example. Of a dozen or more dunes visited, at least three would be satisfactory as bison traps. Two years after I first visited one, it had changed significantly. A long ridge of sand had been deposited and a stand of grass had even started on it, providing a relatively easy path out of the trough of the dune. The dune would still have been a usable trap, but it certainly would not have been as efficient as when first observed.

THE LATE PLAINS ARCHAIC PERIOD

In terms of bison procurement, making a distinction between the Middle and Late Plains Archaic may bring about an artificial and unwarranted boundary. Bison jumping continued at the Kobold site and arroyo traps are present although few of the latter have been investigated. The bone levels for the Late Plains Archaic at the Kobold site showed severe deterioration but large numbers of projectile points (Figure 5.41a, b) were recovered. Minimal investigation was done in an arroyo trap south of Upton, Wyoming. This was a typical arroyo trap with a date of 2150 B.P. ± 150 (RL–350). The Keaster site to the north (Davis and Stallcop 1965) is an important Late Plains Archaic bison kill site, although it is more of a Northern Plains manifestation. Enumeration of other, similar sites of the same general period would be of little value to this discussion.

However, one rather distinctive cultural group of bison hunters introduced a markedly increased measure of sophistication to the bison pound or corral on the Northwestern Plains shortly after the beginning of the Christian Era. Two sites are known for this manifestation, one in the southeastern Powder River Basin in Wyoming and the other in the Shirley Basin on a drainage of the North Platte River in south-central Wyoming. The first site, known as the Ruby site (Frison 1971a) is on a dry tributary of the Powder River a few miles west of prominent landmarks known as the Pumpkin Buttes, which roughly mark a point between the Powder River–Cheyenne River divide and the head of the Belle Fourche River. The second is the Muddy Creek site is on a small tributary of the North Platte River. Together the two sites represent a cultural manifestation known as Besant (see Reeves 1969; Wettlaufer 1955), which has cultural affiliations to the north and east.

Besant: The Ruby and Muddy Creek Sites

The Ruby site was in operation at a time when the alluvial deposits of the dry tributary of the Powder River were aggrading, and when the tributary followed a broad meandering pattern. The aggradation process continued until the site was covered by up to 9 feet of alluvial deposits. Subsequently the cycle changed to one of degradation, and most of the alluvial and colluvial deposits in the arroyo were removed except in some of the meander bends (one of which was the location of the Ruby site). The degradation pattern was much less meandering than the former pattern of aggradation so that many of the former meander bends were not affected. It has not been possible to perceive the advantages of the site location in terms of bison handling because of these

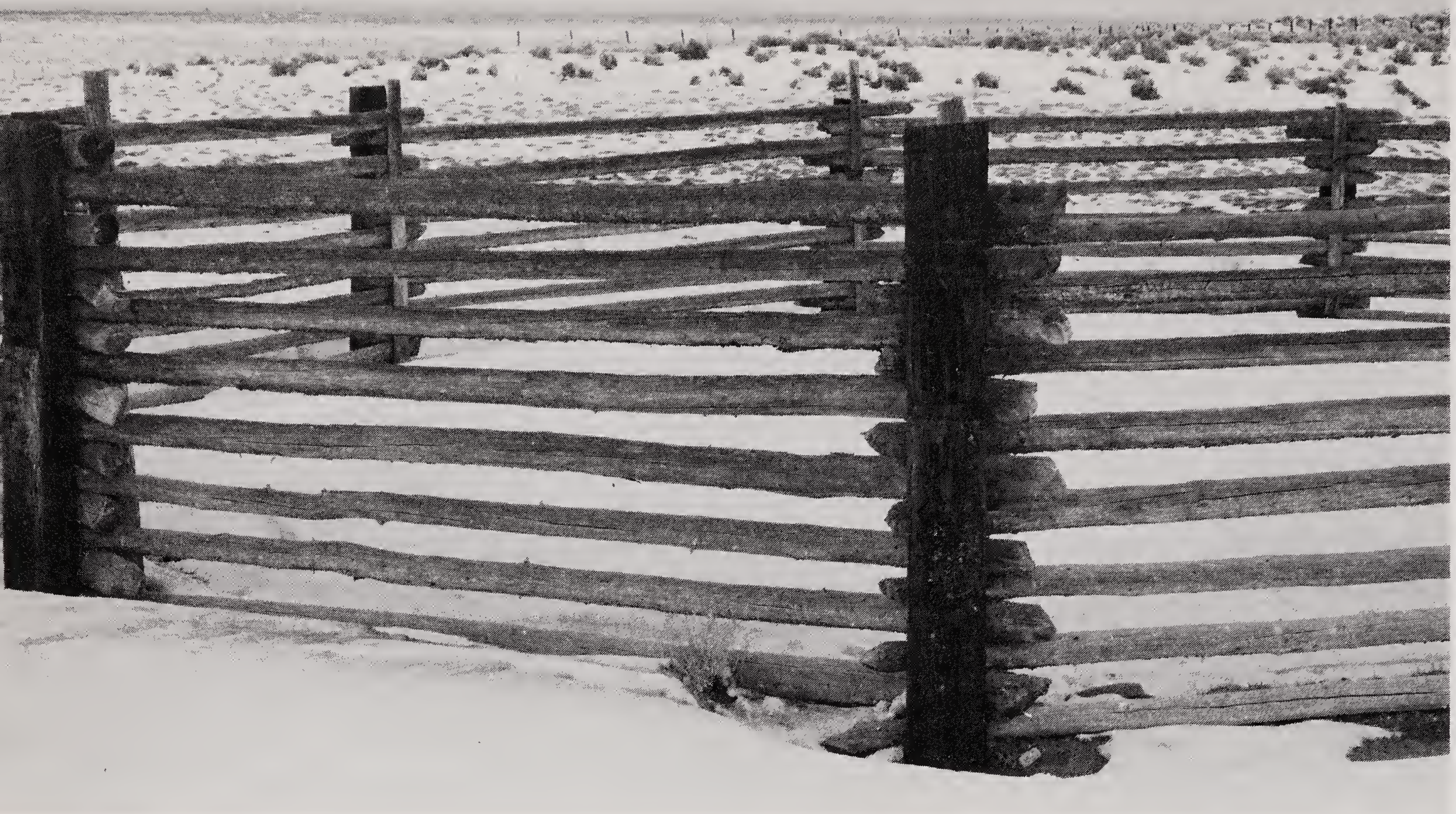


FIGURE 5.37. Typical modern corral construction.

changes in the terrain. The degradation cycle cut into and destroyed part of the site, but also revealed its presence.

The Ruby site reflects a high level of knowledge, resourcefulness, and dedication in prehistoric bison procurement. The structures involved in the procurement operation would be adequate for corralling buffalo today, and were probably equal or even superior to many present-day cattle corrals. They might be considered as a prototype of the modern cattle corral. The latter are usually constructed by planting posts in pairs separated by a distance equal to the diameter of the horizontal poles used in the above ground part of the structure. The distance between pairs of posts is less than the length of the horizontal poles so that the poles can be stacked alternately on top of one another so that the distance between the horizontal poles is also equal to the diameter of the poles used (see Figure 5.37). I would argue strongly that the Ruby site bison corral was built in precisely this manner (Figure 5.38a). The horizontal poles were probably large enough and sturdy enough so that the bison could not force an exit even if they could see out between the poles. And properly motivated bison, especially bulls, have been known to tear up corrals that appear quite strong and well built.

On the other hand, there is evidence that the Ruby site corral underwent varying degrees of destruction and rebuilding. The corral was built on a slope, which requires the downslope side of the corral, where the greatest stress was exerted, to be the strongest. Few people have observed bison in corrals closely enough to realize their strength, especially when one is being gored by another one. This kind of situation undoubtedly happened many times during the Ruby site operations. Peeling the downslope side of the Ruby site bison corral revealed more than one building stage and each one of these probably represents repair or rebuilding of parts of the structure. Building the structure on a slope

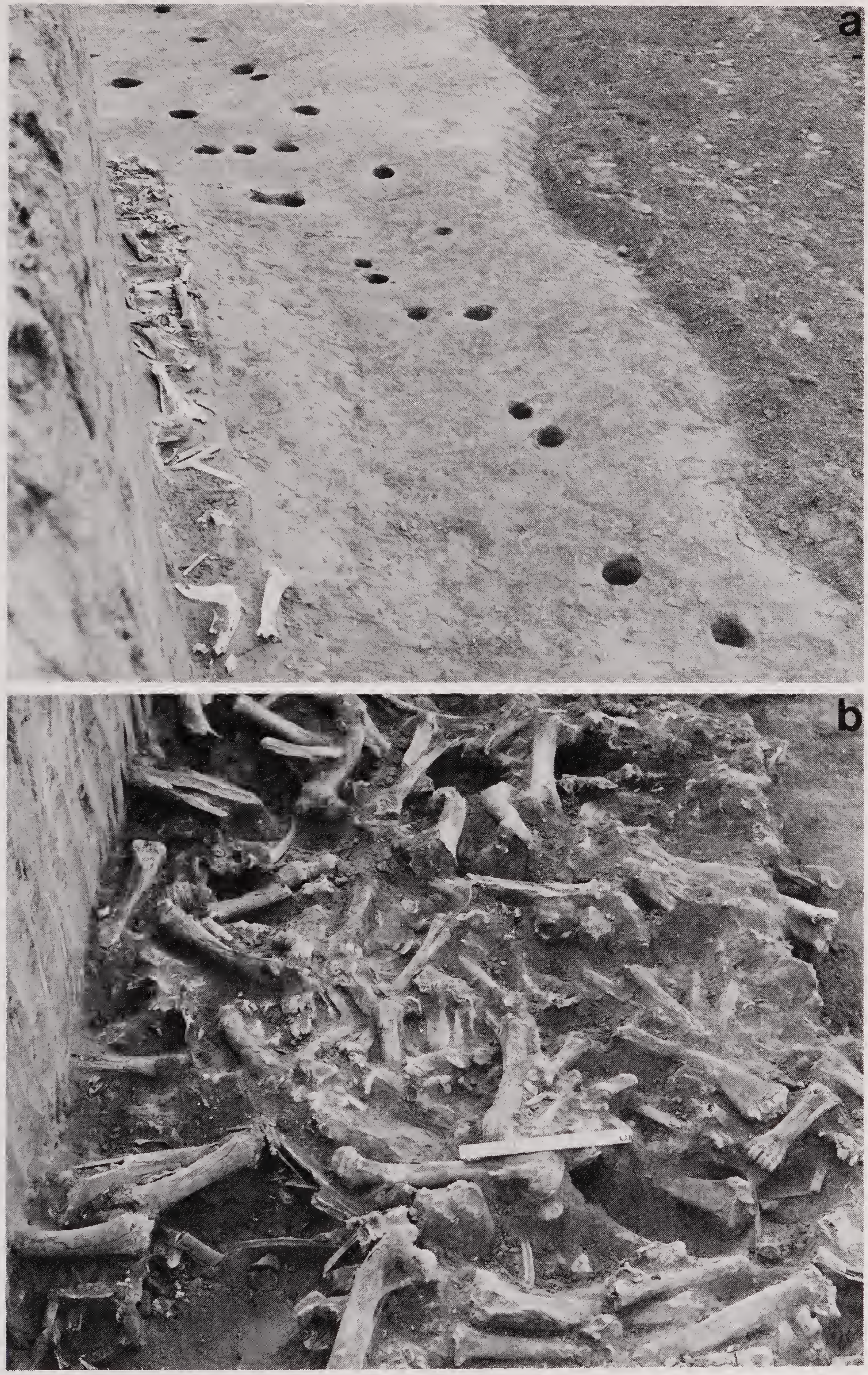


FIGURE 5.38. Postholes at the edge of the bone bed (a) and part of the thick bone bed (b) at the Ruby site.

may seem like a poor decision but actually it was not. We can assume that the prehistoric hunting group's only interest was to kill the animals. They were not interested in any of the operations that occur in a present-day corral, such as roping, cutting, branding, dehorning, and castrating. The Ruby site corral would not be amenable for the latter, but it would be for the former. An animal—bison or domestic cow—running uphill or along a steep slope is at a definite disadvantage in jumping or going through a fence. On the other hand, the downhill side of a corral built on a slope is the ideal spot for crowding animals for killing—provided it is strong enough. The upslope parts of the corral need not be as strong as the downslope parts. This would save effort in construction. The evidence at the Ruby site supports these contentions.

The actual construction and materials needed for a corral that would hold bison might be considered. Such a structure might be round and about 40 feet in diameter, with poles 12 feet long. Allowing for overlap, this would require paired postholes 10 feet apart. Outside circumference would be about 125 feet so that 12 panels 10 feet apart would require 26 posts and leave a 5-foot gate. One hundred and twenty poles approximately 5 inches in diameter on the small end and 7 inches on the large end, if stacked 10 high beginning a foot from the ground, would provide a structure 7 feet high that would hold bison. Wings would have to be built out from the entrance. The several panels close to the entrance would have to be just as well constructed, but from there on out the wings need not be so strong nor the posts so close together. Wings need to extend for at least 100 yards depending on the terrain and the number of persons heading the bison into the wings. Today the work would probably be done by a person using a chain saw and a power-takeoff posthole digger mounted on a tractor or other vehicle. The posts and poles would probably be purchased at the local lumberyard and one man could construct a bison-proof corral in a day or so. Wings out from the entrance to funnel the animals into the corral would probably require another day.

Without such sophisticated tools, two men using axes and crosscut saws would have spent 2 days cutting and hauling the poles and another day cutting and hauling the posts. At least 2 or 3 days would have been required to dig the postholes with an iron digging bar and shovel, set the posts, and lay up the poles. At least another day or two would have been needed to construct the wings. In comparison, the prehistoric hunting group was burning off rather than cutting at least some of the posts although some may have been picked up. The dry arroyo has a good stand of juniper and cottonwood. Cottonwood groves and juniper thickets are always characterized by quantities of dead wood, much of which would be usable in corral structure both for posts and poles. Remnants of posts left in the holes at the site were juniper, much superior to cottonwood, which rots quickly and is structurally inferior.

We are quite certain that the postholes were dug with bone tools such as bison ribs and broken mandibles, some of which were found at the site and bore evidence of this kind of use. Wooden digging sticks could also have been used. The alluvial soil is easy to dig into. I postulate that a hunting group consisting of 20 males mobilizing the efforts of the entire social group might have required a period of 10 days to 2 weeks to construct the Ruby site bison

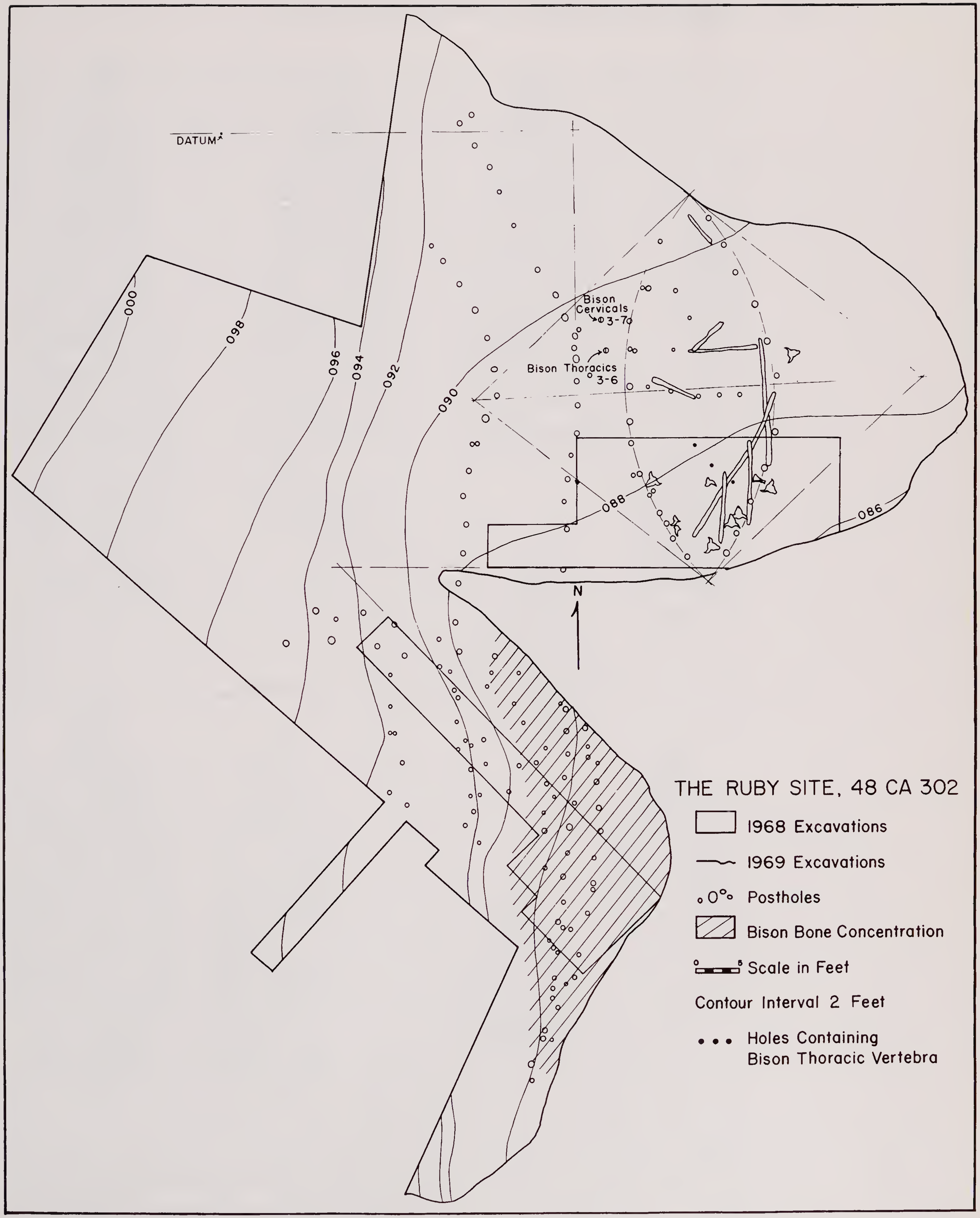


FIGURE 5.39. Map of the Ruby site.

corral, final drive lane, and wings. This is a considerable investment in time and effort and the complex was probably intended to be used for a long time.

The final drive lane at the Ruby site argues that the hunters were experienced and knowledgeable on the subject of bison behavior. Before the lane reaches the entrance to the corral, there is a deliberate bend, obscuring the corral entrance until the last possible moment (Figure 5.39). This is a much superior design to a straight-line approach, as any livestock operator knows. Bison moving down a drive lane they are unable to see the end of are much less apt to balk and turn around than they would be if the drive lane were straight. Also significant is the fact that at a point where the trap entrance first becomes visible from the final drive lane, projectile points begin to appear. This suggests actions analogous to the prodding of the animals today with a sharp stick or electric prod at the moment they can perceive the end of the drive lane and perhaps attempt to turn around. The best insurance against bison turning is constant pursuit from the rear and a good prod from behind in exactly the right spot at the proper moment by someone stationed outside the drive lane.

In addition to the final drive lane, there were undoubtedly expanding wings to funnel animals into the trap. Natural features such as ridge tops and arroyo banks may have simplified construction, and one wing may not have been as long as the other. It is possible to crowd a bison herd against a fence and follow it toward a corral so that the other wing need only be extended a short distance. Placing the corral structure on the arroyo floodplain may have been deliberate, in that it was several feet lower than the surrounding country so the operation was hidden from view until the animals were crowded well into the funnel formed by the expanding wings. At this point the close pursuit by the drivers worried the animals enough to distract them from their immediate surroundings.

The kinds of bison-driving activities just described are not things that can be learned by reading books. The bison is a large animal that appears to move awkwardly and think slowly, but a few minutes in a corral with one will rapidly dispel this kind of thinking. Although large, they are anything but awkward. And although their reactions to the same stimuli used in handling domestic cattle are similar, they react much faster. Bison can be successfully handled in a corral such as the one at the Ruby site only by experienced personnel. They have to be pursued in exactly the right way and prodded at exactly the right moment from exactly the right position. Any other action will bring on the wrong reaction from the animal and the whole effort will be wasted.

The downslope side of the Ruby bison corral was filled to a depth of over a foot with badly decomposed bison bone (Figure 5.38b) indicating that a good many animals had been killed. Large dart points (Figure 5.40e, f) were recovered in the drive lane and bone bed. About 1000 feet up the arroyo and on the same side of the arroyo is a large processing area that has been only briefly tested. It is covered by up to 8 feet of alluvial deposits, so proper investigation will require heavy equipment. At least 10,000 square feet of processing area is present. Investigations to date in the processing area indicate a number of

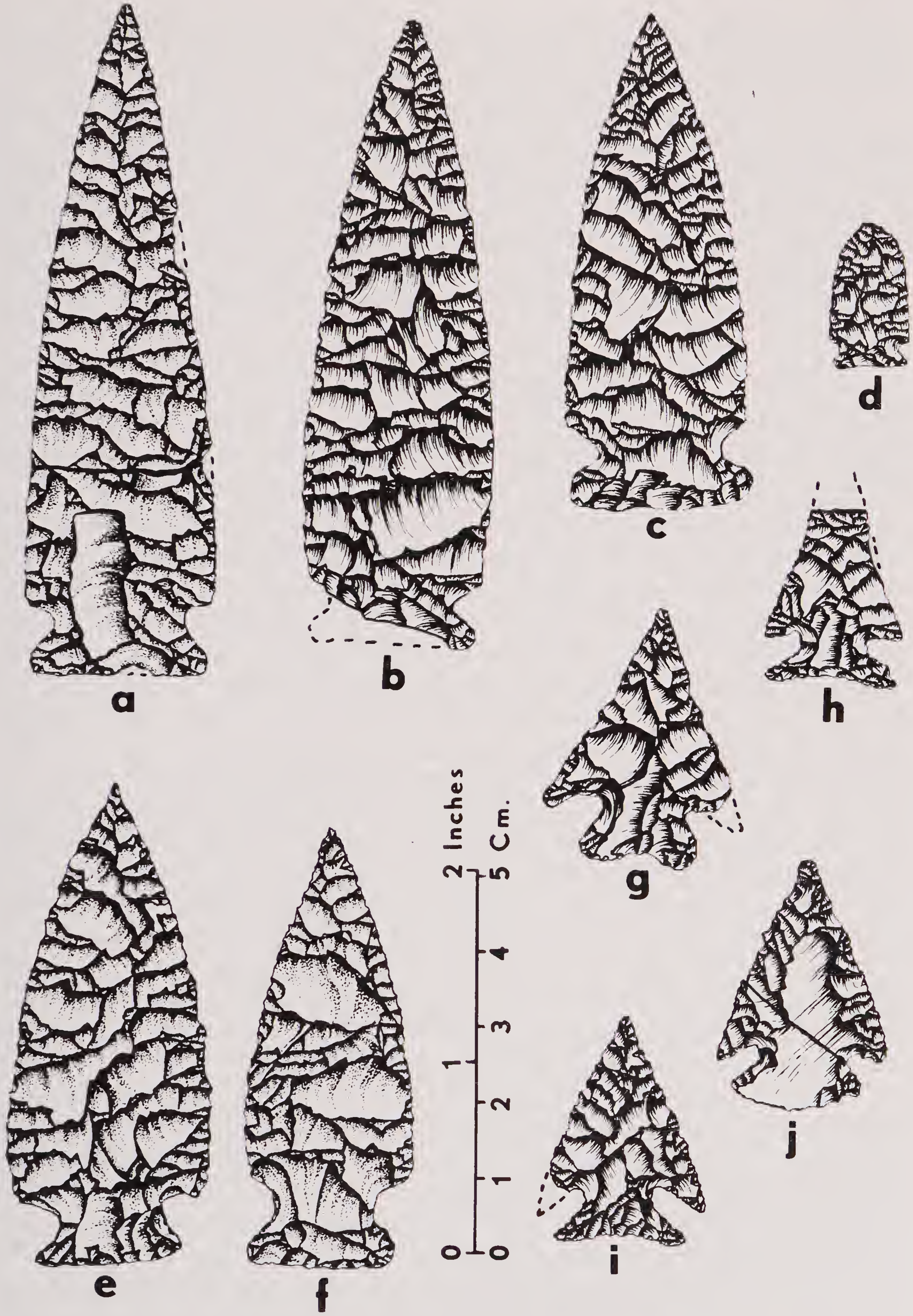


FIGURE 5.40. Projectile points from the Muddy Creek (a–d), Ruby (e, f), and Medicine Lodge Creek (g–j) sites.

discrete but similar processing activity areas—indicating that although the kill effort was communal, once the distribution of the products of the kill was made, further processing was probably done at the family level.

The corral and drive line complex was not the only major building effort at the Ruby site. The procurement complex reflects a thorough knowledge of bison behavior but this was strongly buttressed by whatever additional help was available from supernatural sources. The sophistication of the corral and related structures was matched or superseded by a religious structure alongside the final drive line. Identification as a religious structure is based on a number of features associated with the structure and the architecture of the structure itself.

A look at the site map (Figure 5.39) reveals a structure 39 feet long and 15 feet wide formed by two intersecting arcs of circles of approximately 33.5-foot radii. The structure was almost certainly outlined originally by setting two stakes 51 feet apart and then marking off the two interesting arcs. Postholes outlined the bipointed structure, which is oriented almost to true north.

The aboveground details of the structure are obscure, although the aggradation of the alluvial and colluvial deposits was fast enough to fill the structure for a depth of over a foot before it collapsed, preserving many of its features. The structure was divided into two parts by five postholes across the widest part. The southern half of the structure was definitely roofed over but the northern half may or may not have been roofed. The badly decomposed remains of a juniper log about 20 feet long lies on top of a similar log 15 feet in length. The shortest is believed to have spanned the structure across the widest part and the longest one was a ridgepole that reached from the south end to the center. Two shorter juniper logs were on top of the longest and appear to have been rafters extending from the longest pole to the edge. Their positions would suggest the structure fell to the east with the ridgepole on top of the center cross log and the two rafters on top of the ridgepole. The rafters suggest some sort of a roof, but no evidence of this remains. The postholes outlining the structure were set perpendicular, so we are assuming the sides were the same. The height is purely conjectural but the remains of three other logs that may have been the above ground parts of posts are present, and if they were, the sides of the structure may have been between 5 and 7 feet high.

Other unusual features were associated with the structure. Three small holes in the southern half each contained a vertebra with the longest dorsal spine of a bison (second or third thoracic) with distal ends in the ground and proximal ends aboveground. Three similar small holes in the north end of the enclosure contained nothing. Two holes just outside the structure to the west contained respectively four thoracic vertebrae with dorsal spines downward and the entire series of articulated cervical vertebrae with atlas at the bottom of the hole. Around the south end of the structure were eight male bison skulls without mandibles. Some disturbance was obvious but most had been placed face up, noses out along the fence line of the structure. In addition the area of the enclosure bore no evidence of having been a living structure. Lacking entirely were fire hearths and activity areas associated with conventional living structures. Also, the structure and its associated features bear no resemblance to any known prehistoric living structures on the Plains.

Reliance on the supernatural was a common occurrence in communal kills. Mandelbaum (1940:190–191) mentions that the Cree pound or corral was built under a shaman's supervision and the latter was empowered to do so by a spirit helper. In addition, the tipi of the pound-maker was placed by the entrance and it was here the shaman sang and smoked to invoke his spirit helpers. This sounds exactly like what was occurring at the Ruby site buffalo corral, only the shaman's structure there was much more than a simple tipi. Many other related examples of shaman activity associated with bison kills, as well as kills of other species, are known (see Frison 1971a:87–88).

The other bison corral that is closely related culturally to the one at the Ruby site is in similar country but about 100 miles to the southwest. Muddy Creek, a small, meandering, live stream at its beginnings, becomes an ephemeral one before flowing into the Little Medicine Bow River, which in turn flows into the North Platte River. The corral was situated about a quarter of a mile west of Muddy Creek at the base of a steep slope about 400 feet high that forms a scarp extending several miles to the east. The flats along Muddy Creek provided an excellent bison habitat in several square miles of grazing and gathering areas. For the bison to reach the corral, they were herded upstream, possibly several miles if necessary (herds were probably closer most of the time).

As with the Ruby site, the Muddy Creek bison corral was on sloping ground. Details of the structure are not as clear as at the Ruby site since most of the site deposits were only a few inches below the surface and were actually exposed in some places. The corral was apparently about 40 feet in diameter and single postholes were used, possibly because of the large logs available. Two postholes excavated were of larger diameter than at the Ruby site. The Muddy Creek site is located close to stands of lodgepole and limber pine, which must have eased the problems of corral construction considerably. It is much easier to obtain and prepare poles and posts of pine than of cottonwood and juniper which was probably the case at the Ruby site.

The selection of the location for the Muddy Creek bison corral demonstrates a careful consideration of natural features present. The terrain from a distance appears quite flat but considerable relief is actually present. The corral was placed where a low, narrow ridge hid the entire operation from view until the last possible moment. We have no evidence of a religious structure at Muddy Creek but, if its location coincided with the one at the Ruby site, which seems a reasonable assumption, recent gullying has removed it and part of the main drive lane. However, little doubt remains as to the way in which the approach to the site lay and what manipulations were necessary to move the bison.

Neither the Ruby nor the Muddy Creek site was designed to handle large numbers of animals at one time. A corral or pound of this nature was not strong enough to be even half-filled with bison. A nursery herd of about 25 animals seems about right, although a few more animals would not have caused an undue strain on the structure.

The animals along the fence are not the ones that crowd a fence and break it down. In fact, the animals along the fence will push against the animals crowding them; animals backed up one or two deep are not usually able to cause much strain on a fence. When too many animals are in a corral the animals will be stacked up so deep that those along the fence are powerless and a strong barrier is necessary to withstand the pressure; corrals such as described here were simply not that strong. Modern buffalo raisers are aware that they can either handle bison in small numbers or build stronger corrals. When the corral is too strong and too full, some animals, especially the smaller and weaker ones, are crippled and killed. This was not a problem of the prehistoric hunters because they did not have the technology to build indestructible corrals. On the other hand, the arroyo bison trap with solid perpendicular walls may have been more efficient than we realize; part of the strategy may have been to crowd excess animals into the trap and let the animals injure themselves as much as possible.

The projectile points recovered at the Ruby (Figure 5.40e, f) and Muddy Creek (Figure 5.40a–c) sites stand out as some of the best known. The hunters expended extra effort to acquire the best of raw materials, which include local quartzites and cherts. In contrast to all other bison kill sites up to this time, there are no projectile points at either site that can be considered inferior. One miniature projectile point recovered at the Muddy Creek site (Figure 5.40d) may have been part of a shaman's equipment.

The highly functional nature of the projectile points in question is expressed by the best of raw materials, sharp, penetrating points, sharp blade edges, and proximal ends specially designed to provide great strength and to lessen the chance of destroying both point and shaft during impact. Notches are usually on the side and these and bases are heavily ground. Needle-sharp points expand rapidly to relatively thick lenticular cross-sections but basal thinning was carefully executed to provide the optimum for hafting. Flint technology reflects a high degree of skill. As at the Hawken site, usable pieces were reworked whenever possible, resulting in a considerable expansion of the range of projectile point styles from a more narrow range of archetypes. Most of the projectile points used are believed to be dart points although some are large enough to have been used on the end of thrusting spears.

The first analysis of the teeth and mandibles from the Ruby site was done before reliable techniques were developed through tooth eruption and wear analysis. The first estimate was that the calves at the Ruby site were 4 to 6 months of age (Frison 1971a:87). A reevaluation of the Ruby site bison materials indicates that the age of the calves was actually about 5 to 8 months, indicating a period of use throughout the entire fall. The Muddy Creek site provided a poor sample of preserved teeth because of the closeness of the site deposits to the surface, but those found suggest about the same range of calf ages and seasonal activity, with a possible extension of use to early winter. Both site samples were small and as a result population structure assessments were not possible.

In summary, the Besant cultural incursion into the Northwestern Plains brought with it, or else developed there, the most sophisticated bison procurement methods the area had seen. Hunters were able to incorporate sophisticated artificial structures into certain features of the natural topography and produce highly efficient buffalo corrals or pounds. As a result, these hunters were less dependent upon the arroyo trap and the jump and consequently could set up operations in a wider variety of favorable bison habitat areas. Of particular interest is the effort expended on the construction of the two corrals and the Ruby site religious structure. The latter indicates that the shaman's role in communal bison procurement was of considerable importance by at least about 1800 years ago. The corrals, the weaponry, and the drive lane complexes reflect a high level of competence in handling bison and careful attention to the various details that helped ensure success. The religious structure at the Ruby site indicates that all possible supernatural help was also called upon to ensure the success of events that had a high probability of failure. Besant was actually a cultural climax—at least in terms of bison procurement—that was never reached again on the Northwestern Plains.

THE LATE PREHISTORIC PERIOD

Communal bison procurement reached its greatest prehistoric expression—in terms of numbers of animals killed at least—during the Late Prehistoric period on the Plains, although all the known procurement methods were present before this. Whether use of the bow and arrow resulted in more efficient killing of bison in corrals or in close-range situations is open to question. The bow and arrow seems to have been accepted quite rapidly, but it does not follow that its use directly resulted in the increased emphasis on communal procurement. There was an increased emphasis during the Late Prehistoric Period on the bison jump or slight variations of this, at least on the Northwestern Plains.

Dart points and bow and arrow points can usually be distinguished by size. The long, heavy shaft and projectile point used with an atlatl and dart do not travel as fast as the shorter, lighter shaft and projectile point used with a bow and arrow. The evidence from bison kill sites indicates that one is about as effective as the other since penetration of bison bones was about the same for both dart and arrow points. Perhaps the sudden popularity of the bow and arrow was due to a combination of many attributes. The smaller projectile points could be manufactured from more easily obtainable quarry materials, and they were easier to make. Arrow shafts are also easier to manufacture than dart shafts. The atlatl dart has to be relatively long to yield accuracy and it is difficult to carry very many of these. This is believed to be the reason for the foreshaft. A large bundle of these could be carried easily. When a projectile was lodged in an animal, it separated from the mainshaft, which was then retrieved to be used again with another foreshaft. A bundle of arrow shafts, each one complete, seems a much better solution, being more portable and more dependable. The bow has a longer range than the atlatl and dart and proficiency with the former is quicker and easier to attain. For the atlatl to be used effectively, the body has to be in a position to deliver the proper thrust. The upright position is best because the whole body can be brought into play to give added thrust. Other positions, such as kneeling, are possible, but thrust is impaired. Underbrush constrains the action of throwing a dart more than that of drawing a bow. A bow can be drawn effectively by the hunter whether he is standing, kneeling, or even lying on his back and incorporating the use of his feet. Perhaps the greatest advantage of the bow is that it can be drawn slowly and deliberately, involving no violent movement on the part of the hunter. In other words, the bow was more versatile and easier to control than the atlatl. It is easy to understand why the bow and arrow rapidly replaced the atlatl and dart.

The Wardell Site

The earliest known evidence of a communal bison kill involving use of the bow and arrow on the Northwestern Plains was found at a site in the Green River Basin near Big Piney, Wyoming. Known as the Wardell site (Frison 1973b), it was a bison corral close to the Green River used by hunters to intercept bison herds moving back and forth between grazing lands and water. Intermittent use over a long period of time is suggested by nearly 5 feet of stratified bison bone levels and radiocarbon dates that span about 500 years. A large butchering, processing, and camping area is adjacent to the kill and has only been partially investigated.

The location of the corral, at the base of a low, steep scarp at the confluence of two small arroyos, was well chosen. Steep slopes on three sides aided in the strengthening of the corral, part of which is outlined by both paired and single postholes. Parts of juniper posts remain in some of the holes. Groves of cottonwood are plentiful along the nearby Green River; juniper grows in the site area. As at the Ruby site, both juniper and cottonwood were probably used in construction. Erosion has removed all evidence of drive lanes and other structures that may have existed. Other than the fact that the kill area deposits at the Wardell site are characterized by large numbers of bow and arrow points (Figure 5.41c, d, f), the operation is somewhat reminiscent of that of the Ruby and Muddy Creek sites a few hundred years earlier.

The Wardell site involved several hundred animals killed over a period of years. Part of the corral deposits was removed by gullying, but excavations involving less than an estimated quarter of the total kill area produced remains of nearly 150 animals (Figure 5.42). We have no way of knowing whether the corral was partly cleaned at various times or how much of the bone material was taken to the processing area, so the total count of animals killed is a guess.

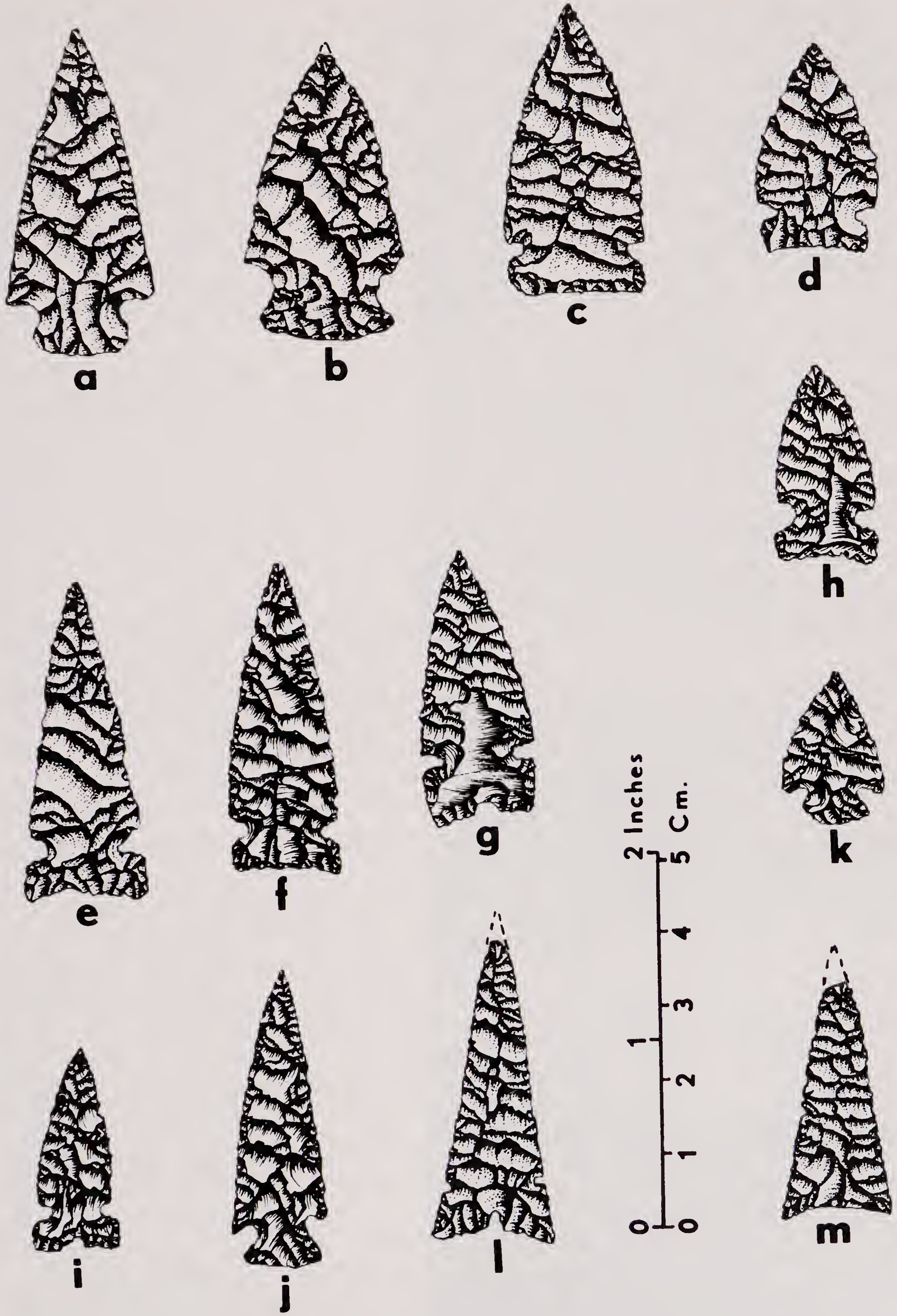


FIGURE 5.41. Projectile points from the Kobold (a, b), Wardell (c, d, f), Glenrock (e, h), Piney Creek (g, i), Willow Springs (j, k), and Vore (l, m) sites.

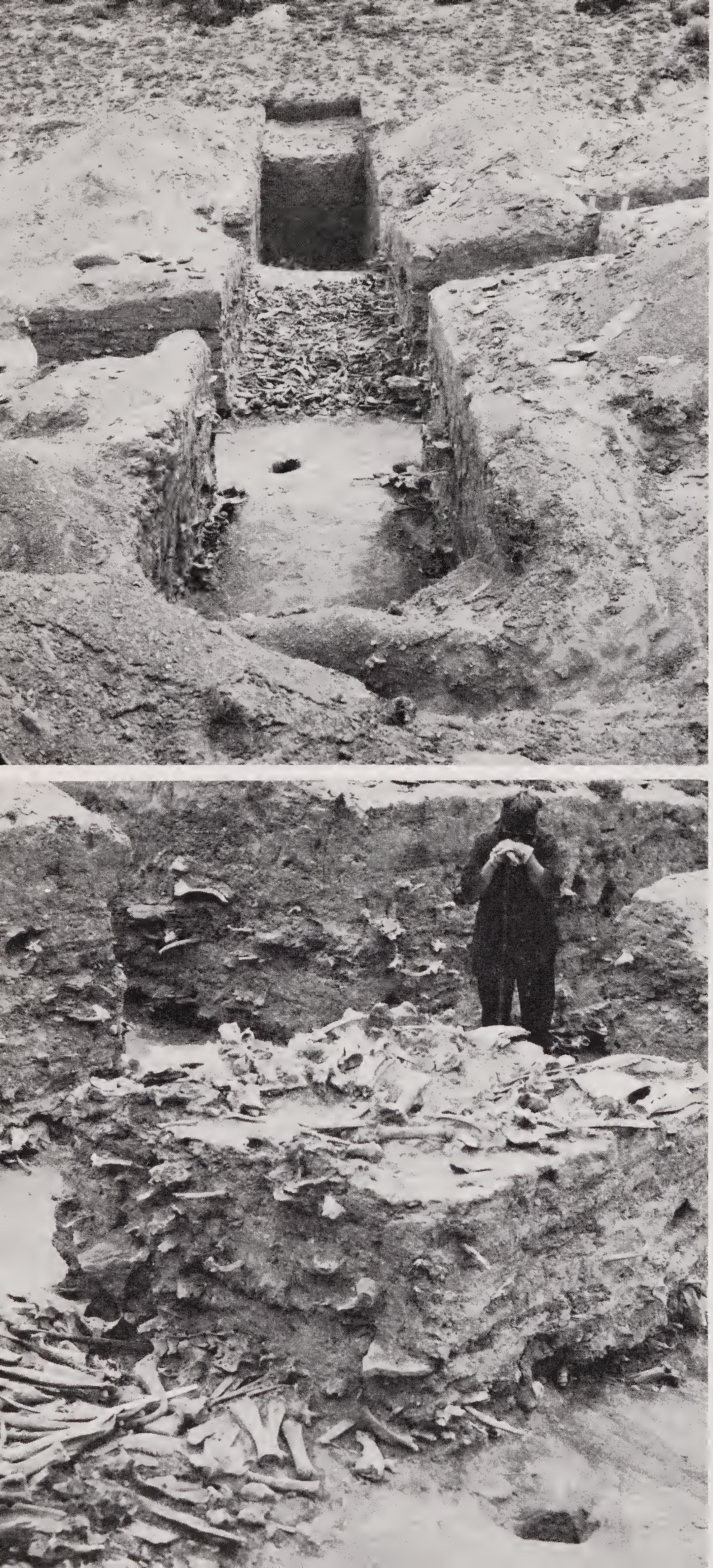


FIGURE 5.42. Buffalo bone levels at the Wardell site. Trench exposing post holes, an old arroyo, and the bottom level (a), and a block exposing the stratigraphy (b).

However, 1000 appears to be a conservative figure. The recovered sample was large enough to use for a reliable population study. The results indicate that the kill or kills were restricted to early fall. Population structure in terms of the number of animals in the various age groups poses a number of problems which may result from methods of carcass handling in butchering. Young animals, especially those in the first two age groups (calves and yearlings) are not properly represented in our sample. This may be the result of butchering processes, although alternative hypotheses must be tested. Sixteen age groups (based on tooth eruption and wear) indicate a longer-lived bison population than for the Casper and Hawken sites where only 12 age groups could be defined.

With the exception of obsidian, the raw materials used to manufacture Wardell site projectile points were of local origin. Neutron activation studies on obsidian sources and Wardell site specimens indicate that the point manufacturers were familiar with several obsidian sources in the Grand Teton and Yellowstone National Park areas, over 100 miles to the north. Wardell hunters drew material from obvious and accessible sources such as Obsidian Cliff in Yellowstone National Park, but they also exploited difficult-to-reach sources such as one close to Teton Pass in an extremely isolated area. The obsidian used suggests that the Wardell site hunters were familiar with the rough, mountainous areas in the Upper Green River and Snake River drainages and that much of their summertime movements and activities may have been centered there. There is also the possibility that obsidian was obtained through trade or some other institutionalized activity.

The limitations of arrow points are demonstrated quite well at the Wardell site. Two mature bison ribs demonstrate direct hits and in both cases the projectile point tips carried just into the interior cancellous bone and the remainder of the point broke. One of these points had been carried around in the rib for some time, judging from the buildup of pathological bone around it. The bison may have been hit during a previous corralling attempt a year or so earlier at the same location. The other specimen was a rib that bore no pathological buildup of bone around the projectile point and was probably from an animal killed in a site operation at the same time the abortive rib shot was made. Neither of these wounds would have resulted in more than slight discomfort to the animal, demonstrating that an arrow point had to penetrate between the ribs just as a dart point or thrusting spear. In contrast, a rifle bullet of the common hunting calibers would have shattered the rib, penetrated the rib cavity, killed the animal, and then lodged against the hide on the opposite side.

About 200 feet south of the Wardell bison corral is the edge of a processing–camping area that may cover as much as 2 acres. Bison completely dominate the faunal assemblage here as expected, although small numbers of antelope, jackrabbit, cottontail, and sage grouse bone appear in the cultural deposits. I have a strong feeling that most of the bison meat was being stripped and dried for future storage while the hunting group lived off the remainder of the bison and other animals and birds that lived nearby. The processing–camping area is characterized by several distinct features. These include stone-heating pits, stone-boiling pits, and cooking or roasting pits. The first are wide, shallow pits in which fires were built and into which stones were placed to be heated. The second are about the same dimensions as the first, but were first lined with a green bison hide or emptied paunch, and then filled with water, broken bones, and hot stones. The boiling water released the grease from the bone, and the grease was retrieved as it floated to the top of the water and solidified. Some meat may have been boiled also. Roasting or cooking pits are slightly different. At the Wardell site, these were usually in the shape of inverted cones up to 2 feet in diameter and about 1 foot deep. They were probably lined with something—possibly a buffalo paunch—and various butchered units were placed inside along with several hot stones. The top of the pit was then covered with dirt and in at least one case flat slabs of stone, and sealed. The contents would have been cooked in several hours. The stone-heating pits and the cooking pits (see Chapter 10, Figure 10.5) were common features at the Wardell site, whereas the presence of stone-boiling pits is more conjectural and postulated mostly from evidence at sites later in the period.

One of the roasting pits at Wardell had never been opened by the hunters, for some unknown reason. When excavated, the pit contained at least seven discrete butchered units from bison along with several large fire-fractured stones. Several flat stone slabs and a layer of soil covered the entire pit and had never been removed. All other roasting pits that were found had been opened, and although the hunters left some individual bones and larger units in the kill area most were taken to the camping–processing area for further preparation. Perhaps the meat was entirely stripped from the bones and units left at the kill area, whereas those taken to the camping–processing area still had flesh remaining and were then prepared for immediate consumption. The general character of butchering and food preparation argues against wastage of any bison products.

The camping–processing area produced a significant amount of ceramics. One reconstructed vessel indicates an elongate form with a slight restriction at the neck, no shoulder, and a pointed bottom. No decorative motifs are present but technology is by no means inferior compared to other locally known ceramics. Because there is little similarity to other known ceramics in the area, there may be a link to Athabascan movements in the Southwest, since pottery of the Largo-Gallina phase in the Southwest as well as some Plains Woodland pottery bears a superficial resemblance to that at Wardell. The pottery also bears a resemblance to historic Navajo ceramics. As yet nothing has been done to test this hypothesis.

To summarize, the Wardell site is a continuation of the same kind of bison procurement that was going on at the Ruby and Muddy Creek sites except that the bow and arrow now replaced the atlatl and dart. The site was used over a long period of time, possibly several hundred years, but not every consecutive year. Time of year was restricted to the early fall and a strong argument can be made for procurement of meat to be dried and stored for use during the winter. Cultural affiliations are conjectural but ceramics are apparently not of Crow, Shoshonean, or Southwestern origin, and a possible Athabascan link is suggested. Some of the Wardell projectile points bear resemblance to the Avonlea type common to the Northern Plains but most bear no such resemblance. Even though the dates of the Wardell site are comparable to some of those of Avonlea, it is difficult to claim cultural relationships based only on present evidence.

The Classic Late Prehistoric Bison Jumps

Buffalo jump sites are characterized by a high bluff over which the animals were stampeded so that large numbers of them would be killed and crippled. There are many variations. Steep banks were used, as were perpendicular bluffs and especially ascending scarps of both cut and fill terraces along streams, as long as they were of sufficient height and gradient. Sometimes topographic features are combined as in the Vore Buffalo Jump near Sundance, Wyoming, which is a large, round karstlike depression 65 m across. One side presents a perpendicular jump-off; the remainder is a steep talus slope. The evidence suggests that animals were stampeded into this sinkhole, which is about 15 m deep, from a number of directions. The direction of any particular drive was determined largely by the initial location of the herd. The perpendicular jump-off may have actually killed in contrast to crippling more animals than the steep talus slope. If the talus slope was used, the sinkhole may have taken on some aspects of a trap. Many animals would have been crippled but few killed, so they would have had to be killed by the hunters. The large numbers of projectile points among the bones can be interpreted as evidence for this.

There was a fundamental difference between the jump and the corral and the necessary conditions for one in some ways excluded the other. The jump relied on a large number of animals. Small numbers of bison simply cannot be regularly and successfully stampeded over a jump-off. The secret of operating a jump is to have enough animals moving close together at a high rate of speed, so that when the lead animals balk or try to turn sideways the mass of moving animals behind prevents them from stopping or turning and carries them and many others over the precipice. The leader or leaders of a small herd can detect a jump-off in time to stop, turn sideways, or do a 180° turn. Unless some force is there that is of sufficient magnitude to carry the animal over the jump-off, the animal in question will be able to avoid it. Even with trained cow horses, no 3 knowledgeable cowhands could force a single bison or even four or five over a jump-off, at least with any regularity. In a herd of a dozen or so, the same 3 cowhands might be able to get an animal over, but only under special conditions—for example, if a large animal is frightened enough to charge through the rest of the herd and in the process gives a smaller animal enough of a shove to push it over. The same 3 persons could get a herd of 50 or so bison in the right position, stampede them toward a precipice, and occasionally get a few animals crowded over the edge. They would probably not be able to repeat the process with any regularity. On the other hand, 10 mounted, well-trained cowhands should be able to take 100 head of buffalo, maneuver them into proper position, and stand a better than even chance of stampeding a substantial number over the edge. There is one reservation even here, and that is that on some days even 10 men on horses may not be able to maneuver the animals into the proper position. If this situation develops the best alternative is to go back home and try again another day.

For trapping in a typical corral or arroyo trap the smaller herd is easier to handle. The animals have to be kept close together and they have to be maneuvered constantly to get them in exactly the right position. Individual animals will continually attempt to scale the banks of an arroyo as they are being driven up the bottom, and these animals must be turned back into the bottom because if one is successful in getting away, the others will try to follow. In rougher country, such as is usually encountered as the arroyo traps are approached from gathering areas, the lead of a herd tends to separate from the drag or the animals to the rear. This problem is not as difficult to rectify with a smaller herd. It is a mistake to start out with a big herd, thinking that small groups can be split off until the desired number of animals is reached. The sight of some of the animals escaping almost always causes the remainder of the herd to follow. The only reliable method is to gather a herd of the proper size and keep it together for the entire operation. Such is the nature of the bison. The large herd could not be handled in a small corral or trap and the small herd could not be stampeded over a bluff.

The Late Prehistoric buffalo jump was usually characterized by long lines of stone piles called *drive lines*. The stone piles were usually not large: some contained only 4 or 5 boulders; others, 20 or more. Short grass can hide the drive lines during a normal grass year. Cowhands and others have been known to ride over miles of drive lines for years without noticing their presence. Yet they are quite obvious to the archeologist interested in the methods of prehistoric bison driving.

Drive lines had an important function in the handling of bison. They were usually placed in such a manner as to impart information to the drivers that would aid them in moving a bison herd. Moving a bison herd was more than merely running along behind them. The herd had to be prevented from stampeding at the wrong moment. It had to be manipulated in order to keep it on a predetermined path. Failure to do so resulted in the loss of the herd. Bison react positively and quickly to driving pressures. The secret to driving bison over a jump or into a trap without horses is to locate the proper feature and determine whether it is so situated that bison can be brought to it. Then each hunter has to become totally familiar with the territory. The drive lines serve as reference points to help the hunters coordinate their movements with those of the buffalo. These movements have to be perfectly timed. Split-second responses to movements of the animals usually mean the difference between success and failure. Bison may in many ways be regarded as stupid but they are not slow or incapable of instantaneous reaction. Bison have been one of the most successful mammals in North America and their near demise resulted only from a superior technology introduced by Europeans.

Drive lines may have had supernatural significance. The whole communal kill operation was carried out in a context of shamanistic controls, and although the drive lines reflect a thorough understanding of bison behavior, the shaman undoubtedly provided an added measure of security for a successful operation.

The drive line complex is composed of two parts. The part designed to bring a herd into the proper position for the final stampede has just been described. The final drive lines form the second part and usually consisted of two straight lines of stone piles that converge at the jump-off. Usually the bison herd was carefully maneuvered to a predetermined position back from the jump-off, then given a turn close to a right angle, after which an all-out effort was made to stampede it in a tightly packed formation toward the jump-off. The turn was important; the strategy was to keep the bison from seeing the jump-off until the very last minute. After the sharp turn the hunters changed tactics; instead of carefully manipulating the animals they did everything they could to make them panic. However, the stampede had to be controlled. The animals had to be kept together in tight formation, pushed at top speed, and headed in exactly the right direction. Even a slight deviation in the approach to many jump-offs would have sent the herd down a steep slope instead of over a perpendicular drop, wasting the entire effort. To make sure there was no deviation hunters were hidden behind brush piles, hides, and other artificial means of concealment so they could appear at the stone piles at the proper moment and urge the stampeding animals even more. Very likely the drive lines marking the final stampede were actually stations for these hidden persons. As in all phases of the operation, split-second timing was critical.

The Glenrock Buffalo Jump

The Glenrock Buffalo Jump (Frison 1970a) was not a large operation compared to others but it embodied all the principles of driving and jumping bison without horses. The location is along the North Platte River close to Glenrock, Wyoming, where a scarp several miles long forms several perpendicular drop-offs with good, level approaches. For several miles behind the drop-offs there are streams, springs, and open, rolling country covered with grass. At least three and possibly four discrete bison jumps are known to be along the same scarp, but only one, the Glenrock site, has been investigated.

Drive lines extend for more than a mile back from the jump-off at the Glenrock site. More than one access route is present. One may have proven better than another, or the initial location of the herd may have determined which access route was used. Drive lines leading in another direction were the key to locating another jump at a different location along the same scarp. The Glenrock site itself was an operation that required the hunters to move animals

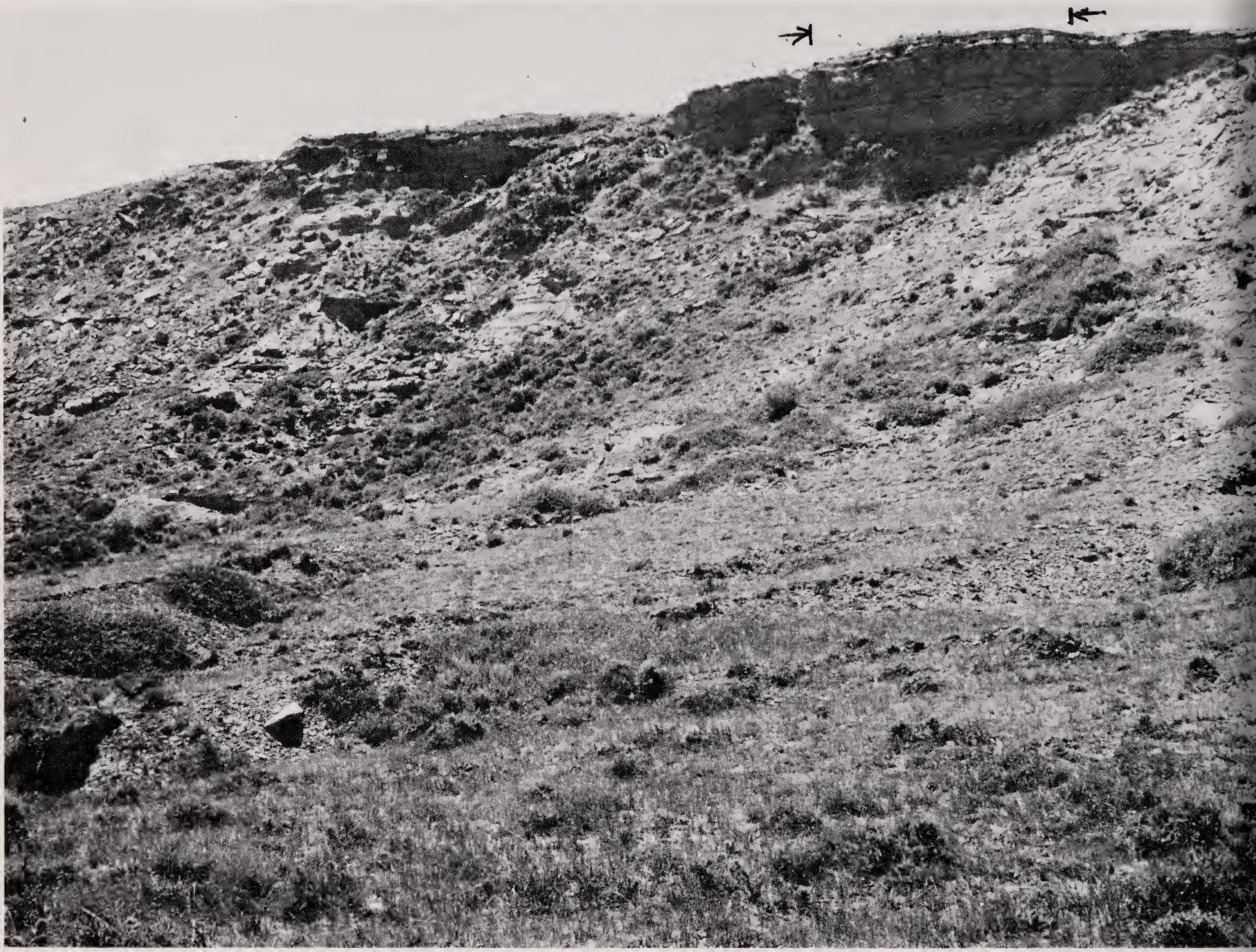


FIGURE 5.43. The Glenrock Buffalo Jump. Animals were driven as far as 3 miles and then stampeded over the bluff between the arrows.

for at least 1 to 3 miles. The effective part of the jump-off is only a few yards wide (Figure 5.43), so tight control of the herd during the final stampede was essential. Final drive lines form a V that terminates precisely at this critical point.

The animals that went over suffered a 40-foot vertical drop and then rolled another 40 feet down a steep talus slope (Figure 5.43). Small arroyos toward the bottom of the slope were filled with bones (Figure 5.44). The paucity of projectile points in the bone deposits suggests that the fall was quite lethal. A high incidence of bones not broken in ordinary butchering processes suggests similar results. The direction of the final stampede was due north but the herd movement leading up to the final drive was northwest or into the prevailing wind. A campsite connected with the jump was never located and cultural

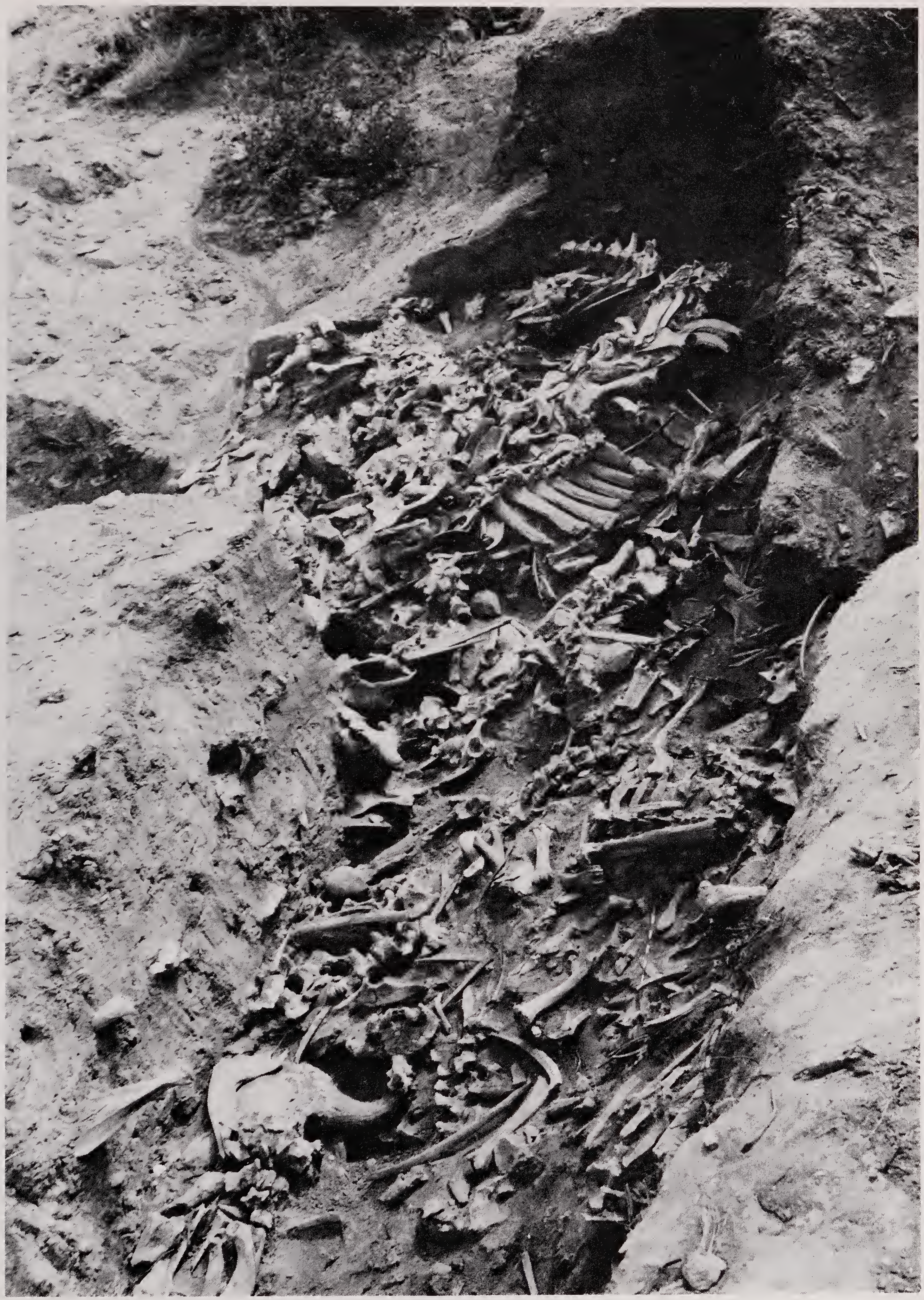


FIGURE 5.44. Bison bones filling an old arroyo at the Glenrock Buffalo Jump.

affiliations are not known. Projectile points were of the side-notched type (Figure 5.41e, h) with some base notching. Most were made from quartzite taken from the Spanish Diggings about 60 miles east and slightly south of the site. The site represents a number of kill operations during the early fall of the year.

At a number of locations along the scarp used in the various jumping operations are single stone circles. These are believed to have resulted from shamanistic activity. One is located close to the final drive lane whereas another is on a rise overlooking the jump, in a position where much of the driving operations could have been observed. These features are smaller (9 and 10 feet in diameter, respectively) than tipi circles and no evidence of fire or other living-site activity appeared in or around them. One is located in a position analogous to that of the structure mentioned earlier at the Ruby site. They are different from any of the many other stone circles nearby—and very unlikely were somehow connected with the activities of the shaman.

The Big Goose Creek Site

The Crow Indians were deeply involved in Late Prehistoric period buffalo jumping and the main center of their activity was apparently in northern Wyoming and southern Montana east of the Mountains. Favorite areas were east of the Bighorn Mountains on the drainages of Little Bighorn River, Rosebud Creek, Tongue River, Big Goose Creek, and Piney Creek. All these areas were excellent bison habitat. Ceramics found at the site indicate that one bison jump, on Big Goose Creek west of Sheridan, Wyoming, is Crow. Like the Glenrock site, the Big Goose Creek site required systematic moving of bison for distances of up to 2 miles. One nearly continuous part of a drive line is over 4500 feet long and consists of piles of 15 to 25 boulders spaced from 1 to 24 feet apart (see front endpaper). The drive line was originally continuous for over a mile but gaps now exist because of irrigation ditches constructed afterward. The animals were driven east or directly to the leeward and there appears to have been no correlation between the direction of driving bison and wind direction. Smell is important if one wishes to approach bison unseen, but in driving, the animals are aware of the humans anyway, so smell is not critical.

At the Big Goose Creek site (Frison 1967a), the animals were gathered and then maneuvered down a long, smooth, gentle slope with a fairly steep scarp on the south side. Several small arroyos demonstrate headward erosion into the scarp and the drive lines were placed along the top of the scarp so as to indicate a path that would keep the animals out of the heads of these arroyos. About 3500 feet from the jump-off a drive line begins to the north, roughly paralleling the one to the south. Further toward the jump-off, the two lines converge slightly to funnel the animals into a narrow, smooth-bottomed arroyo. About 500 feet from the jump-off the herd emerged from the mouth of the arroyo, was given a light turn, and then stampeded toward the jump-off. The final drive lines have been removed by land clearing operations. One side of the final drive lines, however, was a deep, narrow arroyo and many animals piled into

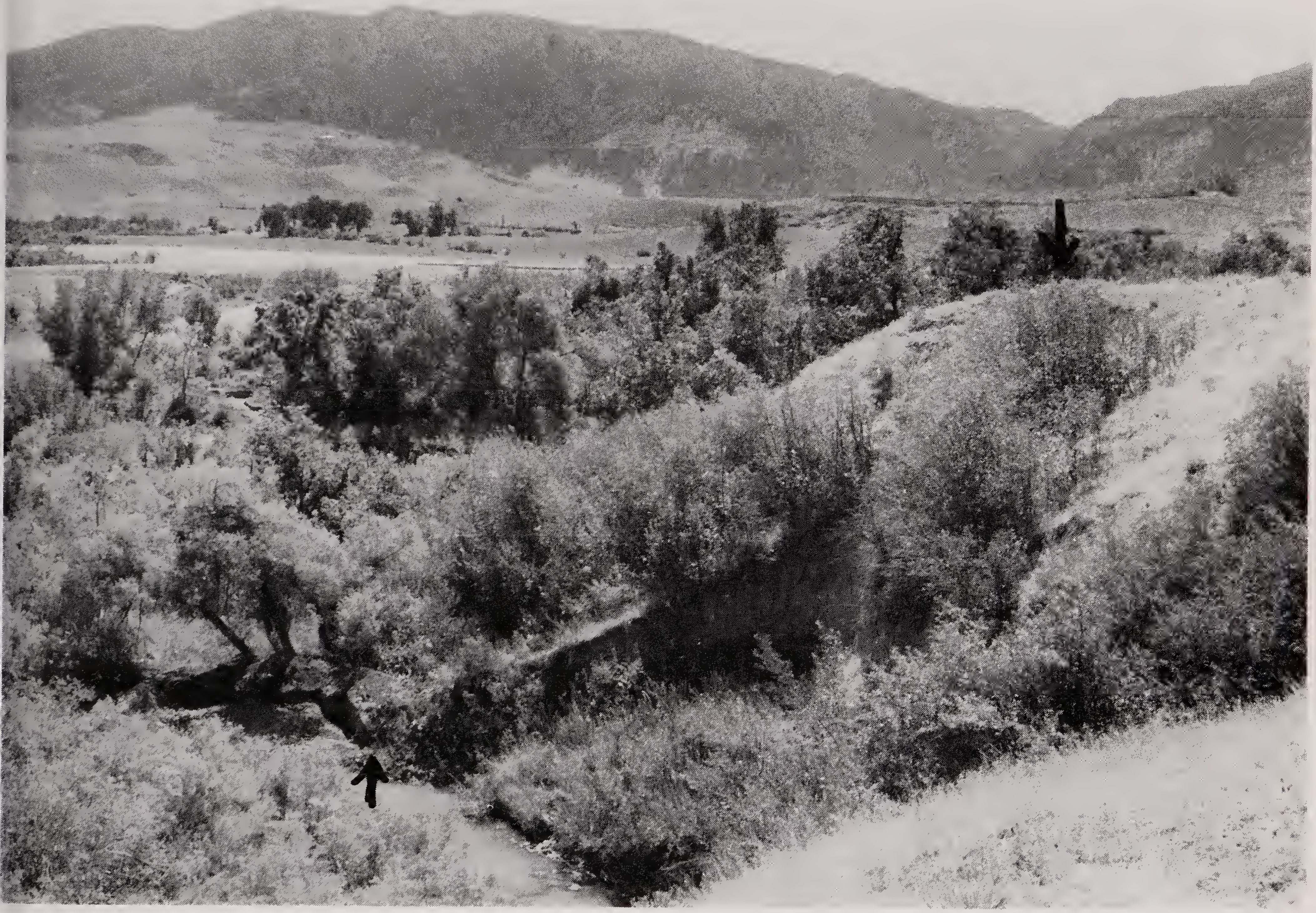


FIGURE 5.45. The jump-off (right arrow) and bone bed (left arrow) at the Big Goose Creek site.

this feature and were killed but were never butchered. They were relatively inaccessible compared to the ones that went over the jump but they still represent one of the few known instances of loss or waste of significant numbers of bison in a communal kill operation. Although they were in a disagreeable location in terms of butchering, a little extra effort would have salvaged at least the better parts.

The jump-off at the Big Goose Creek site was a steep scarp of a river terrace and the animals fell onto the floodplain of Big Goose Creek (Figure 5.45). The scarp was about 50 feet high and apparently quite lethal to the bison as projectile points were scarce and broken bones not a result of butchering were common. The operation took place in early fall. At least five separate levels in the jump suggest that it was used over a period of years. However, all the levels were closely related culturally.

A large camp and processing area was located near the kill area, but

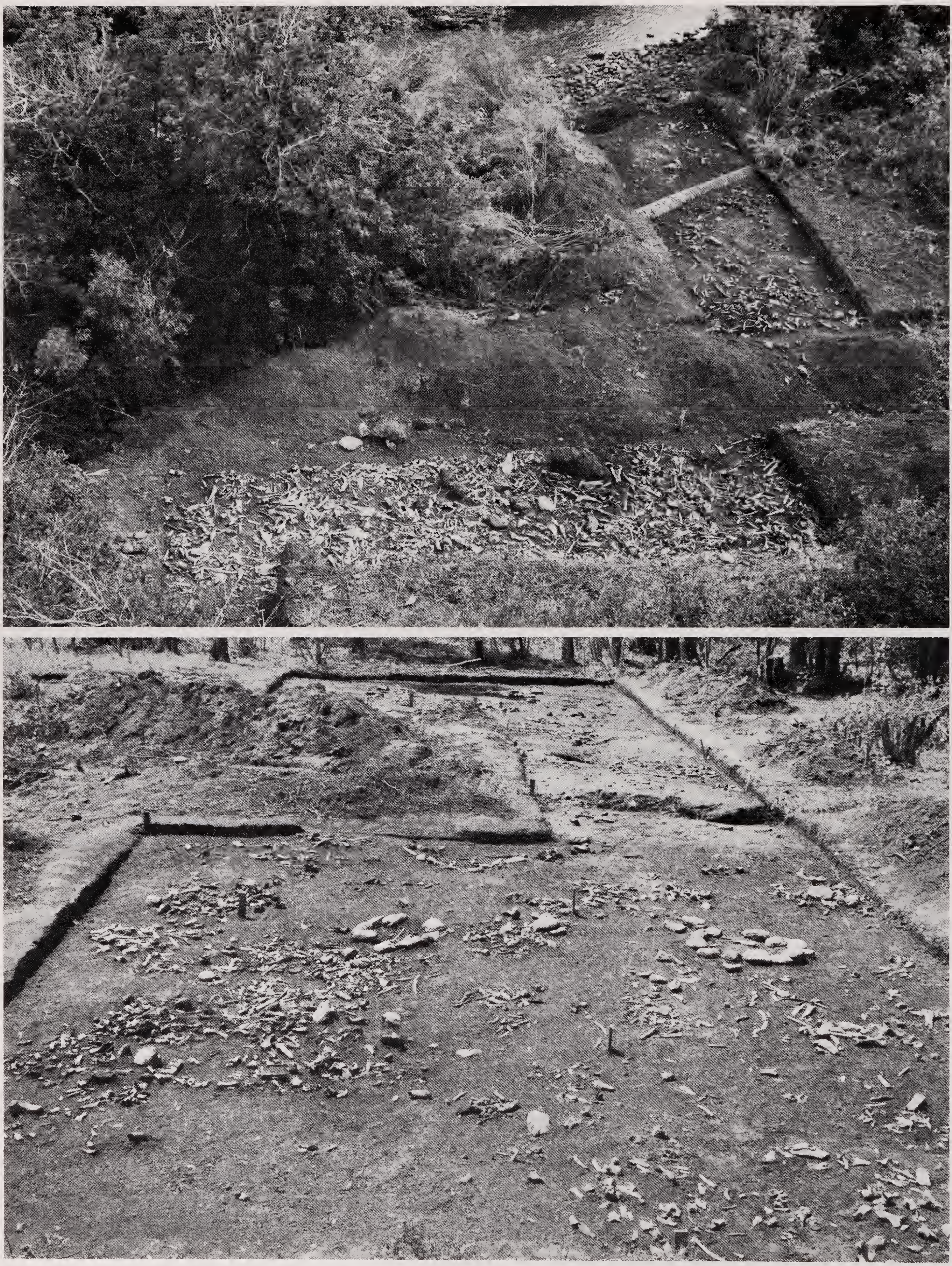


FIGURE 5.46. The bone bed at the bottom of the Piney Creek Buffalo Jump (a) and the processing area (b) to the northeast of the jump.

though it was apparently of the same cultural affiliation as the hunters who operated the jump, it was not directly associated with the animals killed there. Animals in the camp area were killed throughout the winter whereas the ones in the jump were killed in the early fall (Frison *et al.* n.d.). Prominent features of the camp area included stone-heating pits and stone-boiling pits. Small stone rings about 2 feet in diameter formed containers for green hides or bison paunches used in stone boiling; there were also small pits dug below the surface. Quantities of crushed and broken bone surrounding these features suggest the boiling of broken bones for the collection of bone grease. Ceramics in the camp area are believed to be Crow, and although no ceramics were found in the kill, other cultural items strongly indicate the campsite and kill represent the same cultural group. Age determination of animals in the kill was accomplished through tooth eruption and wear analysis, and this was aided in the camp area by a large sample of bison fetal remains in several stages of development. Very likely the Crow cultural group was wintering near the kill and hunting buffalo. They also probably used the stored products of the kills made earlier in the year. The processing area for the animals killed at the jump was probably alongside and was removed by lateral planation of Big Goose Creek subsequent to that time.

The Piney Creek Site

Another Crow bison procurement is located on Piney Creek, about 30 miles south of the Big Goose Creek site (Frison 1967b). Three separate activities can be described. The kill, like that at the Big Goose Creek site, was made over a steep bank onto the present floodplain of Piney Creek (Figure 5.46a) and there may have been some kind of obstacle—such as stacked logs—at the bottom to confuse and delay the animals long enough so they could be killed, but no evidence of such a structure was found. The bank is only about 35 feet high and the larger number of projectile points and fewer broken bones (not the result of butchering) strongly suggest that this site was not as effective as the one at Big Goose Creek. Projectile points were side-notched and side-notched and base-notched (Figure 5.41g, i). No postholes were present, and the bank may have been high enough to kill and cripple a sufficient number of animals. If there was no restraining structure, it is easy to envision crippled and dead animals strewn for a mile or more beyond the jump-off.

About 150 feet downstream from the kill area is a large processing area (Figure 5.46b). Large stone-heating pits are centrally located with regard to smaller stone-boiling pits (see Chapter 10, Figure 10.6). Large anvil stones are surrounded by heaps of broken bone, and hammerstones are present. Around the edges of stone-boiling pits are piles of crushed and broken bones that were presumably boiled for grease. Both belowground pits and aboveground stone rings were used as boiling pits as at Big Goose Creek. The operation was carried out in early fall and processing-area operations coincide in time of year with those at the kill. The Piney Creek processing area, unlike the campsite at Big Goose Creek, was not favorably located for a winter camp; it was damp

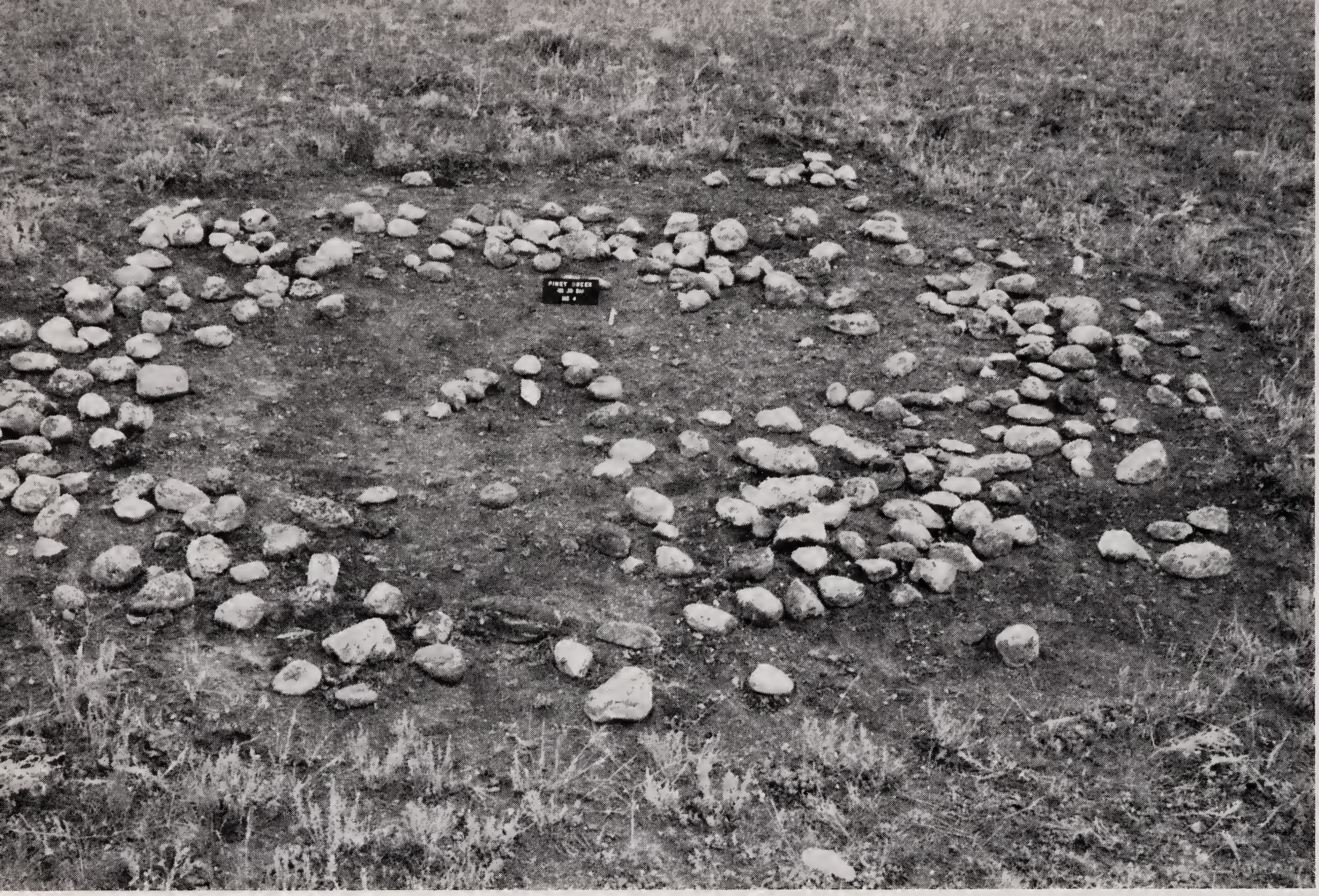


FIGURE 5.47. Tipi rings at the Piney Creek campsite.

and in heavy underbrush at the base of a high steep hill that today prevents sunlight from touching the area at any time during winter months.

A Crow campsite located on a high finger-like terrace remnant about 100 feet above the stream and 2000 feet downstream was very likely used during the operation of the jump. Cultural items, especially ceramics, found in both the campsite and the processing area are unmistakably Crow. The campsite is manifest by 20 stone circles or tipi rings (Figure 5.47) ranging in size from 9 to 14 feet in diameter; one exceptionally large ring was 18 feet in diameter and could have represented the lodge of the hunt leader. Each ring is believed to represent the remains of a conical lodge with stones piled around the bottom to hold it down. The circles do not form any discernible pattern but there was a tendency to concentrate stones at the northwest or windward side, and considering the intensity of the late afternoon storms it was a wise precaution. Central fires were detected in eight of the circles and deflation of soil in most of the remaining ones would have removed traces of fire. There seems little doubt that a campsite of several days or even weeks is represented.

The population of the camp may have been around 120 persons, if we estimate 6 persons per lodge, which is somewhat conservative based on ethnographic evidence. Further speculation suggests that around 20 or 25 active males were present, a reasonable personnel requirement for the operation of a bison jump of this size and complexity. There is evidence to suggest that a high percentage of the bison killed at Piney Creek was utilized and also that at least 200 animals were killed. It is believed that this represents a single season's

operation and would have provided far more meat products than a group of 120 persons could have eaten before spoilage. A large quantity of meat was probably dried, possibly made into some form of pemmican, and then stored in hide containers for use during the winter. This follows a cultural pattern that was close to that observed shortly afterward in historic times. Shoshoneans were described as hanging the meat to dry; when it was partly dried it was pounded between two stones to tenderize it. Then it was put back on the rack to dry completely (Wilson and Driggs 1919:21–22) and when ready it was stored in bags. The Crow came from an entirely different cultural background than the Shoshoneans and further preparation of the meat products into a pemmican was possible. The features at the Piney Creek site argue strongly for pemmican making.

The Vore Buffalo Jump

One of the largest known buffalo procurement sites on the Northwestern Plains is located near Sundance, Wyoming (Reher and Frison n.d.). Technically it can be considered a jump although the geomorphic feature involved is unique. The animals were stampeded into a sinkhole (back endpapers) or karstlike feature 65 m in diameter at the top with sides sloping steeply to the bottom about 15 m below, where the diameter is just over 26 m. At the south end, the side of the sinkhole forms a perpendicular drop in solid sypsum; the remainder is steep talus. The feature is reminiscent of a small crater but is unquestionably a sinkhole in soft, soluble gypsum deposits that is gradually filling up with slope wash. The first bison bones in the bottom may have initiated the filling process.

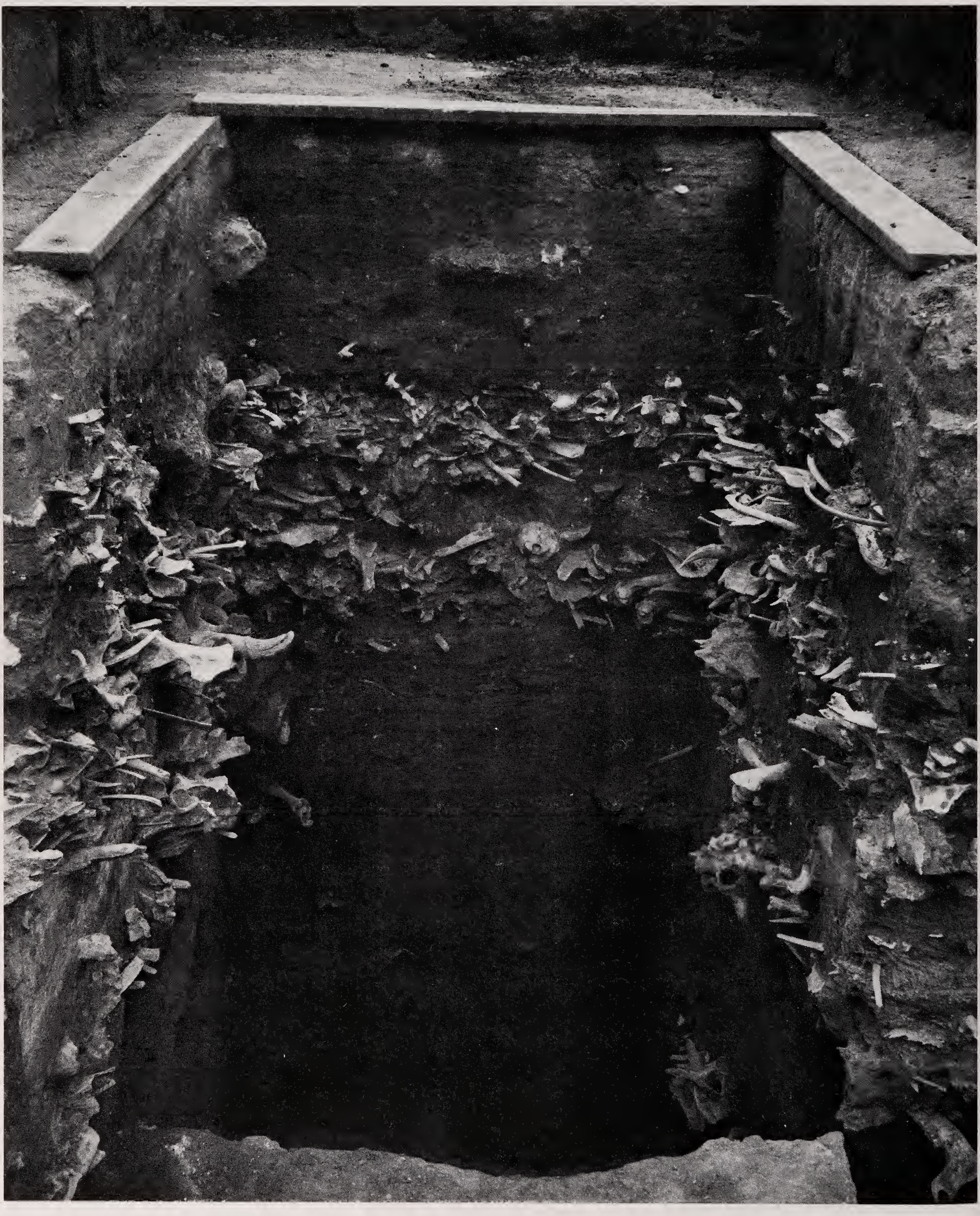


FIGURE 5.48. Stratigraphy at the Vore site.

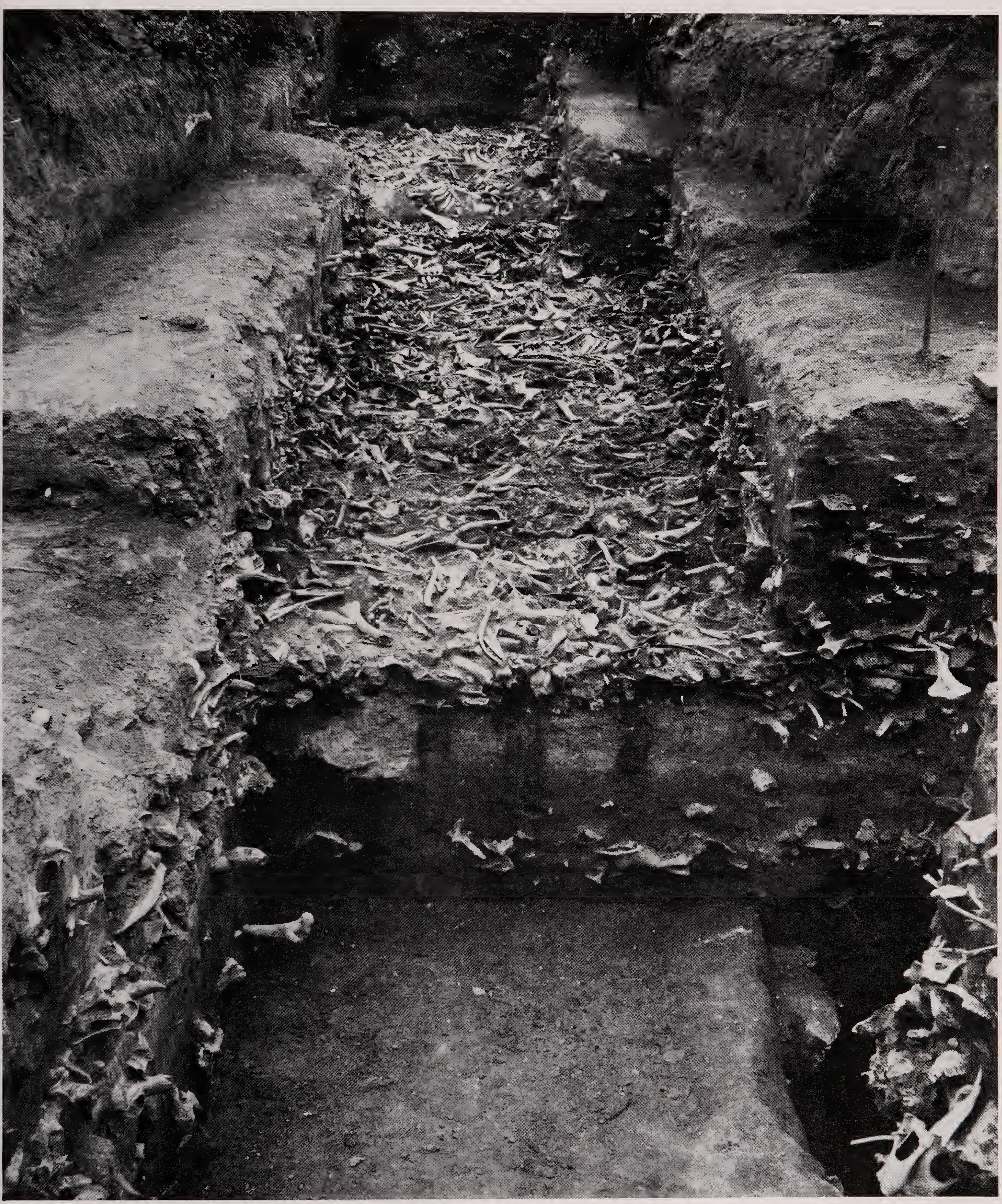


FIGURE 5.49. Bone beds at the Vore site.

The sinkhole is located toward the top of a gentle rise surrounded by open country of moderate relief. At greater distances to the north and south are timbered areas of the Black Hills with greater relief. The sinkhole is difficult to see until one is close to its rim and it is easy to understand why it was used as a bison jump. Stampeding herds of bison would not have realized that it was there until too late. Bison could have been and probably were stampeded into the sinkhole from all directions. One set of drive lines begins more than a mile to the southwest but farming activities have removed the remainder of this and most other similar features that might have existed. Local residents have some memory of these but nothing reliable enough for documentation.

With one exception, all the bison driving at the Vore site was done in the fall of the year. In one level, however, there are large numbers of nursery herd animals killed in late spring, probably shortly after calving time. This we can tell from tooth eruption and wear of several calves and yearlings in the bone deposits. First use of the site began about A.D. 1500 or slightly later. Four feet of sterile deposits overlie the topmost bone level. Below the sterile level are 22 discrete levels of bison bone reaching to a depth of 17 feet. These levels vary from a single bone in thickness to packed masses of bone 3 feet thick (Figure 5.48). The levels extend horizontally completely across the sinkhole (Figure 5.49). The thin levels occur in the upper and lower thirds of the deposits and the central third contains the thick levels. The deposits contain a wide variety of Late Prehistoric period side-notched and side-notched and base-notched projectile points along with stone and bone butchering tools. Near the top were both notched and unnotched varieties (Figure 5.41l, m). Less than 10% of the site was excavated and from this it is estimated that the Vore Buffalo Jump could easily contain the remains of as many as 20,000 bison.

Bison bone deposits at the base of a bluff are subject to many kinds of destructive forces. They may be exposed for long periods of time to heat, cold, rain, sunshine, erosion, and scavengers. Even if they are covered by slope was subsequent cycles of erosion may cut through them and bias the recovered sample. Not so at the Vore site. Everything that went into the sinkhole except for what was carried out by the hunting group stayed there and was soon covered with slope wash. Exposure to the elements was short-lived and even immature animal bone had no chance to deteriorate and further bias the sample. Carnivores were unable to remove very much since they would have had to carry whatever they took up 50 feet of nearly vertical talus slope. In other words, the bone deposits at the Vore Buffalo Jump are an unbiased, well-stratified, and well-preserved sample of the bison killed.

Certain kinds of bone tools have been controversial, largely because their manufacture did not leave clear-cut evidence of purpose. Also, evidence of use on these kinds of bone tools is often obscured through deterioration of bone surfaces, especially since tool use was short-lived and discernible with difficulty at times on a fresh tool. The Vore Buffalo Jump with its quantities of essentially unaltered bone provided an excellent opportunity to recover large numbers of these kinds of bone tools with evidence of manufacture and use. Bone tools will be discussed later.

The lowest five components of the Vore site are contained in varved pond sediments. According to the investigators (Reher 1974a; Reher and Frison n.d.), the sinkhole at the Vore site can be considered analogous to a rain gauge 100 feet in diameter and in one profile 282 laminations represent 141 years of accumulation. The thickness of the laminations or varves is assumed to indicate past precipitation accurately. The five separate bison jumping events mentioned have been chronologically arranged within the varved sediments and the results are of some interest. It was found, for example, that the five kills occurred on an average of 4 years after periods of maximum precipitation. In other words, during the 140 years of time recorded in varves at the Vore site (probably beginning at about A.D. 1540–1550) five buffalo kills occurred, averaging one about every 25 years, but only after periods of high precipitation. One interpretation of this is that periods of high rainfall improved the grass, which improved breeding conditions and resulted in a better calf crop. After 3 years (the age of a bison generation) the female calves resulting from the initial spurt of calves themselves had calves and a minor population explosion resulted. This in turn triggered a communal bison kill. The implications of this raise questions that will plague investigators of bison procurement for many years to come.

COMMENTS ON PREHISTORIC BISON PROCUREMENT

I proposed some time ago (Frison 1973b:3–7) that a critical number of bison is necessary in a given area before communal procurement is feasible or profitable. The rationale for this statement was that since the hunters lacked horses the bison drive had a high probability of failure, and also that as a result of animal behavior patterns bison driving was to some extent limited to certain times of the year. To speculate further, a bison herd that had been hazed part of the way through a drive and then allowed to escape was not likely to have been amenable to another try until at least the next day, provided of course it did not move several miles away. Without horses, the hunters might find the herd well out of range. Another herd then had to be available or the whole corral or jump complex would have been idle. As a result, unless there were large enough numbers of animals present, it would have been better to revert to a pattern of individual or small group hunting.

Another idea was that the communal bison drive was an annual affair brought about by the need for meat to be dried for short-term storage and winter use. Obviously this was not the pattern for at least 140 years at the Vore site. The possibility of alternative sites must be considered, but if, as the Vore site evidence suggests, communal procurement was keyed into periods of high precipitation, the alternative-sites idea is not supported either. We must consider an alternative hypothesis. If the critical numbers of bison for jumping were not present, there may have been other procurement methods for which

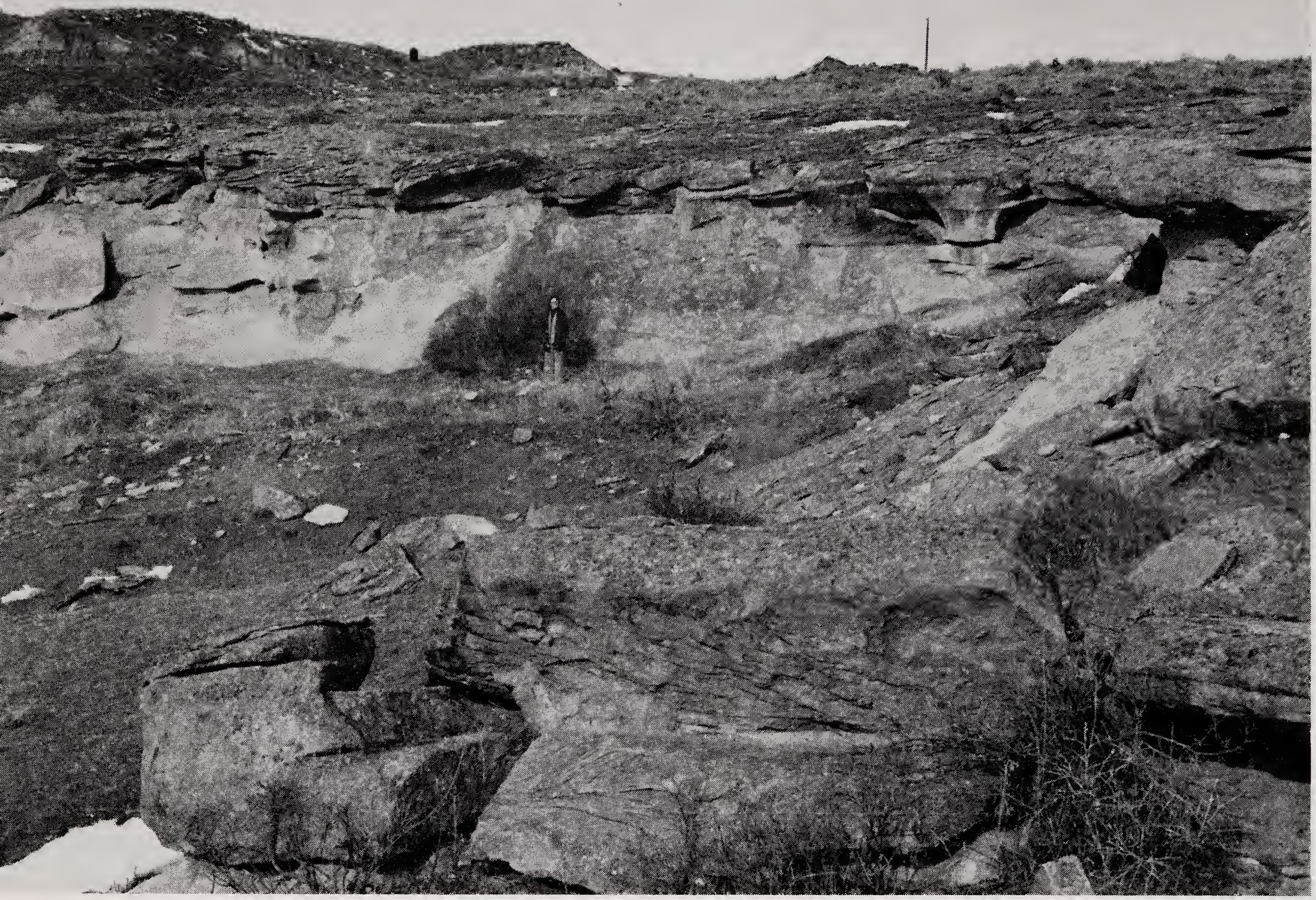


FIGURE 5.50. Buffalo trap at the Foss-Thomas site. The person is standing in the center of the old corral; animals were driven over the bluff at the right side of the picture.

the critical numbers of bison needed were lower. These could have been some form of surround or small trap but as yet we lack this evidence.

On the other hand, the communal antelope drive among the Indians of the Great Basin was not an annual affair because a trapping event depleted the antelope population to the extent that it took several years to replenish it (see Steward 1938). It now appears that a new look must be taken at prehistoric bison procurement with the idea of testing some alternative hypotheses and proposing some new ones. If, for example, the Vore site was the only communal bison procurement site used by a single group of hunters and it was used on an average of once in 25 years, a man in his lifetime might see only two or three of these operations, an unlikely situation. There must have been either alternative sites, alternative procurement methods, or alternative subsistence strategies within the territory claimed by the hunting group. Some of the decisions made were dependent upon local conditions affecting the bison populations.

A common variation of the classic buffalo jump was the stampede over a low bluff or bank into a corral below. These were quite common and allowed the bison hunters to take advantage of many lesser topographic features for successful bison procurement. They were in locations where a perpendicular drop-off was not high enough to kill a lot of animals but would serve as a gate for a corral below. The idea was not new, but like the jump, which dates to earlier times, it was carried to its greatest degree of perfection in the terminal Late Prehistoric period.

Many of these sites could be described in detail but I shall describe them only briefly, since no new bison driving or hunting principles were employed. They actually seem in one sense to have replaced the arroyo trap. Even though they required more effort to construct than the latter, the topographic features necessary for their placement are common within easy access of some better bison habitat areas, at least in the region considered here. And although the arroyo trap is effective, the dead animals were in a spot where it was difficult to butcher them and remove the butchered parts. Use of the arroyo trap was more restricted by weather conditions.

A typical jump and corral of this nature is located at Decker, Montana, and is known as the Foss-Thomas site. A long, gentle slope extends from an interstream divide to an upper terrace of the Tongue River and is interrupted by a perpendicular sandstone scarp about 12 feet high (Figure 5.50). At one spot, a dry wash spills over the wall of the scarp and consequent headward erosion into the sandstone has resulted in a shallow U-shaped notch in the wall and a shallow gully below. A stone fence, which presumably incorporated logs and brush also, was built out from the base of the wall. The enclosure extends 20 feet out from the wall at a right angle on the west side. From here it extends 40 feet east to an isolated sandstone erosional remnant several feet high, 20 feet across at the base and 47 feet from the base of the wall. The sandstone remnant formed an anchor for two sides of the enclosure, which was rectangular in shape and about 45 × 65 feet in size. The gully mentioned was about 3 feet deep and 5 feet wide and was of some significance in the overall configuration of the holding structure since it added to the height of the fence on one side.

Remnants of the final drive lines are present back of the jump-off but no part of a more extensive drive line complex could be located. However, this could easily have been removed by road construction and mining activity. The enclosure contained a thick level of bison bone and quantities of Late Prehistoric period side-notched projectile points, suggesting that the drop into the corral was not intended to kill the animals. The operation took place during the fall, as determined from ages of calves present in the bone deposits; whether this was a single- or multiple-event operation could not be determined. A radiocarbon date of 480 B.P. ± 100 (RL–161), if correct, could mean that it was an early Crow Indian bison procurement operation. However no ceramics were found that could provide more positive cultural identification, nor was a butchering–processing area located. The site represents a successful, well-planned bison procurement operation and also one that required a good deal of communal cooperation for both the construction of the corral and the driving and killing of the bison.

Two almost identical kinds of bison procurement sites are located south of Laramie, Wyoming, in an area of moderate relief along the southern edge of the

Laramie Basin. One of these is known as the Willow Springs Jump. A perpendicular sandstone ledge about 8 feet high was used as a jump-off into a corral, and a long, gentle rise just before the jump-off provided an ideal approach. Postholes and bases of several posts along with fragments of pitch pine logs indicate a structure that was nearly rectangular but that had both corners away from the wall rounded. The corral was approximately 45 feet × 65 feet. Extensive use of this corral is suggested, but in places the bone deposits (up to 2 feet in depth) were burned by an extremely hot fire and as a result the bones were difficult to collect intact. The bones from the last drive at the site were not burned. Burning is not uncommon in bison kills and whether it was accidental or deliberate is not known. The contents of the paunches of 100 bison, when dried, constitute a surprisingly large amount of highly combustible material. This, in addition to a heavy growth of annual weeds (supported by the added nutrients of dead-animal products), would have provided a basis for an extremely hot fire. The remains in the corral may have been deliberately burned to prepare the corral for another bison driving operation, but the fire could have been accidental, resulting from naturally caused grass fires.

The bone deposit contained literally thousands of small, corner-notched arrow points (Figure 5.41j, k) along with smaller numbers of the side-notched and side-notched, base-notched varieties in the upper few inches. Once more this strongly suggests that the drop over the sandstone ledge did not kill the animals and served only as a gate to prevent their escape. Nothing is known of cultural affiliations, although excavations in the Roberts Jump about 40 miles to the south in Colorado produced a flat-bottomed pottery vessel that seems unquestionably of Shoshonean origin (Witkind 1971). Flat-bottomed pottery is found in the Laramie Basin and a Shoshonean connection with the Willow Springs Buffalo Jump is a strong possibility.

One can stand at the Roberts Buffalo Jump in northern Colorado and probably look from one Late Prehistoric period bison jump to another all the way to Canada—excluding much of the Bighorn Basin, not the best of bison habitats because of its aridity and consequent scarcity of grass. Bison were undoubtedly there but not in the numbers necessary for communal procurement exclusive, of course, of the Paleo-Indian period. Many other excellent examples of buffalo jumps are known for the Northwestern Plains and should be described but I do not have the necessary familiarity with them. Among these are the Emigrant Bison Drives near the small town of Emigrant, Montana, located between Livingston and Gardiner (Arthur 1962; Brown, 1932); the Madison (or Logan) Buffalo Jump, south of Logan, Montana, a small town between Manhattan and Three Forks (Malouf 1962); the Keogh Buffalo Jump, east of the foot of the Beartooth Mountains along the Stillwater River about 25 miles from Absarokee, Montana (Conner 1962b); and the Grapevine Buffalo Jumps, located along Grapevine Creek in Bighorn County, Montana (Medicine Crow 1962a). The student of bison procurement must also be familiar with some of the more northerly sites including the Old Women's Buffalo Jump in Alberta (Forbis 1962); Head-Smashed-In Buffalo Jump in Alberta (Reeves 1974); the Boarding School Bison Drive site (Kehoe 1967) near Browning, Montana; the Gull Lake site in southwestern Saskatchewan (Kehoe 1973); and the Wahkpa Chu'gn site in the Milk River Valley of north-central Montana (Davis and Stallcop 1966).

In summary, this chapter documents over 11,000 years of known bison procurement on the Northwestern Plains. The evidence suggests that systematic, communal hunting began early. Folsom groups were aware of bison jumping methods if the data from Bonfire Shelter have been properly interpreted. Trapping methods appear almost certain to have been around considering the age structure of the Folsom site bison and the number of animals at the Lipscomb Bison Quarry. A short time later the arroyo trap and the parabolic sand dune trap were regularly in use and continued in use throughout the Paleo-Indian period. The bison were larger than the modern variant, and they were going through a gradual reduction in size through time. The Paleo-Indians were obviously getting more meat per animal than later hunters.

The Altithermal period is not well understood in terms of bison hunting or the cultural groups present. However, the Hawken site in the Wyoming Black Hills along with the Hawken III site of a few hundred years later provide secure evidence of arroyo bison traps with animals intermediate in size between those of the Paleo-Indian period and those of today. The Black Hills may have been an oasis-like area for both bison and bison hunters during the Altithermal period.

With the return of more favorable conditions after the Altithermal, bison, bison hunters, and bison hunting also returned. The Powder River Basin of Montana and Wyoming was the scene of a proliferation of arroyo traps and at least one (but almost certainly more than one) bison jump. Artificial corrals may have had their beginning about this time and the bison themselves had reached what was essentially their present size.

At about the end of the Late Plains Archaic period an extremely sophisticated group, at least in terms of bison corralling, appeared in the area and were known as Besant. They were building aboveground corral structures that a present-day cowman would not be ashamed of. Drive lanes were constructed that reflect a high stage of understanding of bison behavior as well as the utilization of topographic features. The whole communal effort was strongly regulated by supernatural controls as is evident by a shaman's structure that reflects a surprising amount of effort and skill in construction. The weaponry used was also of a superior nature, as is demonstrated by the quality of raw materials used and the design of the projectile points.

Bison corralling continued into the Late Prehistoric period after the introduction of the bow and arrow. However, later on in the period the classic buffalo jump dominated the scene. Complex sets of drive lines indicate that even without horses the hunters could drive bison herds several miles and control the final stampede to the extent that even a site with a narrow jump-off could be utilized effectively. The low jump-off was a variation that utilized a corral at the base to hold the animals since the trip over the jump-off was not lethal.

The institutional aspects of the communal bison drives are still not entirely clear. They may have been a yearly event and as such were a means of bringing the cultural group together. This would be an important mechanism in reinforcing group solidarity. Some evidence now suggests the communal drive was keyed into ecological factors that controlled the number of animals critical for communal bison kill operations. In other words, the final chapter on the actual nature of bison procurement remains to be written.

OBSERVATIONS ON BISON TODAY

The present-day bison is enjoying a new popularity. Breeding stock is considerably higher in price today than domestic cattle of the same age. Buffalo breeders are quick to defend their choice of bison over cattle. They claim a number of traits that make the bison in some ways equal to or superior to domestic cattle. There is little danger that the bison will replace domestic cattle, but as a result of their popularity enough of them are around for us to make some meaningful observations on bison behavior and to apply these observations to prehistoric situations.

Anyone who works buffalo in the same corral, chute, and squeeze gate facilities that are used in handling domestic cattle has no doubt whatsoever that the buffalo is still a far from domesticated animal. They may appear docile but from what seems the least provocation they can become extremely wild. They appear slow, awkward, and oblivious to what is happening around them. It is often at this point that they change character entirely and react so fast that one often wonders whether he is seeing the same animals.

This does not mean that their reactions are always intelligent in terms of survival. However, their speed and agility can get them away from a given point and unless whoever or whatever is pursuing them has great mobility there is small chance that they will be overtaken. It is easy to see why, even after the acquisition of horses, the Plains Indian tribes had strong sanctions against buffalo hunting before the communal hunt began. Even with horses a herd of bison can be difficult to move in a given direction at the whim of the drivers.

In handling bison today, there are two general procedures to follow. One is to build a set of fences and structures strong enough to hold the animals and to use motorized vehicles with metal wings to herd them. The animals in this situation are handled by brute force and they have no choice but to go into corrals, through chutes, and so on. In this kind of situation, the mortality rate is often high and crippled animals are common. The animals are strong and quick and when frightened they often go completely berserk. If an animal happens to fall down, or gets a foot or head caught or wedged in part of the chute or corral structure, the force of the other animals can only cause injury or death.

The other way to handle buffalo is to be aware of their behavior patterns and adjust your reactions to theirs. Buffalo will not ordinarily crowd a corral fence when inside it unless they want to rub on it. Otherwise they only crowd the fence if forced into it by other animals. The idea that a buffalo will try to push a fence over is erroneous. However, if a bison can get its head through a hole in the fence, it will try to force its way on through. A small group of animals (10 to 20) can be handled in a corral with relative ease, whereas a larger group (50 or more) can be difficult to handle.

It is common to move both cattle and bison back and forth through various sets of corrals during branding, working, innoculating, pregnancy testing, and the like. It is simple to move cattle into a corral, follow them closely, and then close the gate. Not so with bison. Often the group of bison will circle a person several times with unbelievable speed and agility. They may go through the gate into on corral from another, then turn around and come back through the open gate back into the original corral, circle it, and go back into the other corral again. If the person is quick, he or she may get the gate closed before the buffalo decide to come back out again. Once the gate is completely closed they will not force it, but if the person is slow in getting the gate closed and they spy an opening they will crowd it and force their way through.

Cattle are relatively easy to work in chutes and squeeze gates. The method of operation with cattle is to hold a small number in a small pen at the opening to the chute. The chute is then opened so the animal can see the opening at the end. As the animal moves toward the opening, the squeeze gate operator closes it just as the animal's head gets through the opening. This method will simply not work with bison. Once the animal decides to head for open country it moves entirely too fast for any man to react fast enough to squeeze the animal. One buffalo raiser solved the problem by mounting a solid wooden door about 4 feet wide and 6 feet high in upright position on the back of a truck. This can then be moved to within about 2 feet of the end of the squeeze gate and the latter is left open just wide enough for the animal to get its head through. With the solid door only a couple of feet away, the animal does not have a straight path out of the squeeze gate and must go either right or left. Even so, the squeeze-gate operator has to be very alert and catch the animal at the exact moment its head emerges. When the animal is released, the truck is moved forward a few feet to allow the animal to jump free of the squeeze gate without hurting itself. If the buffalo ever gets its shoulders partway through the open squeeze gate there is no way to stop it, even with the door on the truck in place. The buffalo never give up but will continue to struggle until completely exhausted. One advantage the bison has is the narrowness of its shoulders compared to those of a domestic cow. Once a buffalo escapes from the squeeze gate situation it is not easy to get it through the chute again until it has had a chance to quiet down. When a large group of bison are being worked, some inevitably escape through the squeeze gate.

The bison has one noticeable disadvantage. Compared to domestic cattle its hide is quite thin and delicate. As a result buffalo are injured more easily than are domestic cattle. A projection such as a knot on a corral pole will tear a bison's hide open; a domestic cow may slide over the same knot with no more than the loss of a handful of hair. The tenderness of a buffalo hide can be demonstrated in branding. The thin, delicate nature of a bison hide can result in blotching of a brand, and burning too deep into an animal can cause a serious wound. For this reason, most buffalo breeders hesitate to brand their animals. If they do brand, they are very careful not to use too hot an iron and not to burn it as long as with domestic cattle. Bison are valuable today, especially the breeding stock, and it is not profitable to take a chance with a too-hot branding iron causing serious damage to a young calf.

There are also problems when a bison has trouble in calving, which fortunately is rare. If the buffalo cow has to be caught and given help in delivering a calf, she will usually fight so hard that either cow or calf or both are killed or cippled. Even if the calf is delivered successfully, the trauma of the situation is such that the cow may take off immediately after she gets up and desert her calf, which will die unless it can be hand-fed. Compared to domestic cattle, however, bison seldom have problems calving unless an animal breeds too young. They normally have a calf at 3 years of age but an unusually large, healthy calf may breed as a yearling and have a calf at 2 years. This is what most buffalo breeders hope to avoid, since there is no attempt to separate bulls and cows and thereby control breeding. The 2-year-old cow has not acquired the proper growth to allow proper delivery of a calf and is often lost.

Bison are not always predictable in their reactions to various stimuli. Some days they may be docile and appear much like domestic cattle, whereas the next day they may be extremely wild and depart at full speed, running for a mile or more before looking back. Some days it is not worth the effort to try to work buffalo unless they are inside corrals where they can be forced. Cows with young calves are erratic in their behavior and the cows are protective of the calves. It is not at all unusual for a young calf or a group of young calves to stampede in whatever direction they happen to be pointed at the time, and they do not always stick together. The cows take off and follow them and it can take a long time to get them back together.

Animals in rut are probably even more difficult to handle than the ones with young calves. At this time the mature bulls seek out the cows after ignoring them for the remainder of the year. The peak of the rut lasts for about 2 weeks and the entire season drags on for about a month. A cow in heat is the focus of attention of the mature males. A dominant male will try to separate the cow from the herd and at the same time fight off other males. With the kind of activity going on all through the herd there is little possibility of success in driving, corralling, or otherwise working with the herd.

The older mature males are usually disruptive if they are nearby when a nursery herd is being driven. They try to slip away and others will usually try to follow. Forcing them to remain with the nursery herd is not worth the effort. It is best to drive the nursery herd separately from the male herd.

Armed with such information on bison behavior, we can look at prehistoric bison procurement sites as the results of band-level hunting groups familiar enough with the animals to take advantage of their natural behavior patterns. It was through the hunters' knowledge of the limits and possibilities offered by bison behavior that communal bison hunting became an institutionalized economic process for the entire Holocene period on the Great Plains.

6

Prehistoric Hunting of the Lesser Game Animals

ANTELOPE

The American antelope or pronghorn (*Antilocapra americana*) is a distinctive animal in an evolutionary sense and in its behavior patterns. It is commonly referred to as "stinking goat," but neither term applies. Its smell is no more objectionable than that of a bison, elk, or deer and it is not even a close relative of a goat. It is the only game animal in North America that actually sheds its horns. The horn sheaths loosen and fall. The shed horns are usually consumed by rodents and chewed by carnivores and scavengers, so they are not as common a find as might be expected. Another unusual characteristic of the pronghorn is its lack of dewclaws, which can tell the hunter immediately if the tracks he is looking at are pronghorn or deer.

Pronghorn favor open, flat, treeless country. They will range into high elevations, even to the timberline if there is proper access through open country. They seldom hide in the same sense that a deer hides, although they may appear to do so by lying down in tall grass or sagebrush-covered country in the heat of the day. Antelope like to stand or lie down on a rise where at least one of the group can see for long distances. They have excellent eyesight and become extremely wild if hunting pressure is heavy. They are fast and it is not unusual to clock them at up to 60 miles per hour for short distances. They exhibit a strange stubbornness at times. A herd of antelope in level country can be made to run by a person in a vehicle. If the vehicle is kept in just the right position, the antelope will run parallel to the vehicle. The antelope herd can then be properly paced by the person in the vehicle until the animals are brought to top speed, at which time they usually cross in front of the vehicle. If the vehicle goes too fast, however, they will simply run into the distance until they feel it is safe to stop.

Another antelope characteristic is a great curiosity. Any unusual object that cannot be identified, such as a flag or other object placed on the open prairie or preferably on a rise where it can be seen for long distances, will cause the animals to come closer and closer until they can easily be killed. A sure method to obtain an antelope is to camp out in antelope country and put up a small tipi or tent. The next morning a number of the animals are likely to be moving in to see what the object is. When frightened they run at top speed until they are out of sight of whatever they were running from, but then they seemingly forget all about what it was they were running from. Consequently a hunter can easily stalk them.

Antelope will not ordinarily jump fences, although some are now learning to do so. They have learned in many areas to crawl under or through a hole in a fence. But I have more than once seen a single strand of barbed wire contain a herd of antelope because the animals refused either to jump over it or crawl under it. In fact, when cornered, they would double back and run within a few feet of their pursuer rather than go over or under the barbed wire. All things considered, antelope are easy to hunt. They are creatures of habit and appear regularly at waterholes. The hunter can either stalk the animals or sit tight in a good location and let the animals come to him. Either method is effective.

During late fall, winter, and early spring, antelope are often seen in large bunches, sometimes up to several hundred head. Females have their young in late May and early June and are solitary during this period, but they start to run in small bunches as soon as the fawns are a few weeks old. Males may run in bunches of up to 20 and sometimes more during the summer. The rut begins in early September and the gestation period is about 252 days.

Antelope remains have appeared in archeological sites since Paleo-Indian times but the only evidence we have for communal antelope hunting is quite recent. There is, however, no reason to believe that the practice does not have more time depth. A much less sophisticated procurement complex was needed for antelope than for bison and the fences and enclosures may simply have rotted away. The arroyo trap that works for bison trapping is worthless as an antelope trap. Antelope are amenable to both driving and trapping but under an entirely different set of conditions than bison. Fortunately, there are eyewitness accounts of antelope trapping in the Great Basin (Egan 1917:238–241; Regan 1934:54). According to Steward (1938:33) antelope trapping was so successful in parts of the Great Basin that several years were required to regenerate the population. As many as 50 Shoshoneans on horses were able to surround a bunch of antelope and take turns running them in circles until they collapsed from fatigue and were easily killed (Wilson and Driggs 1919). Prehistoric human predation on antelope may have been successful enough to keep their numbers relatively small.

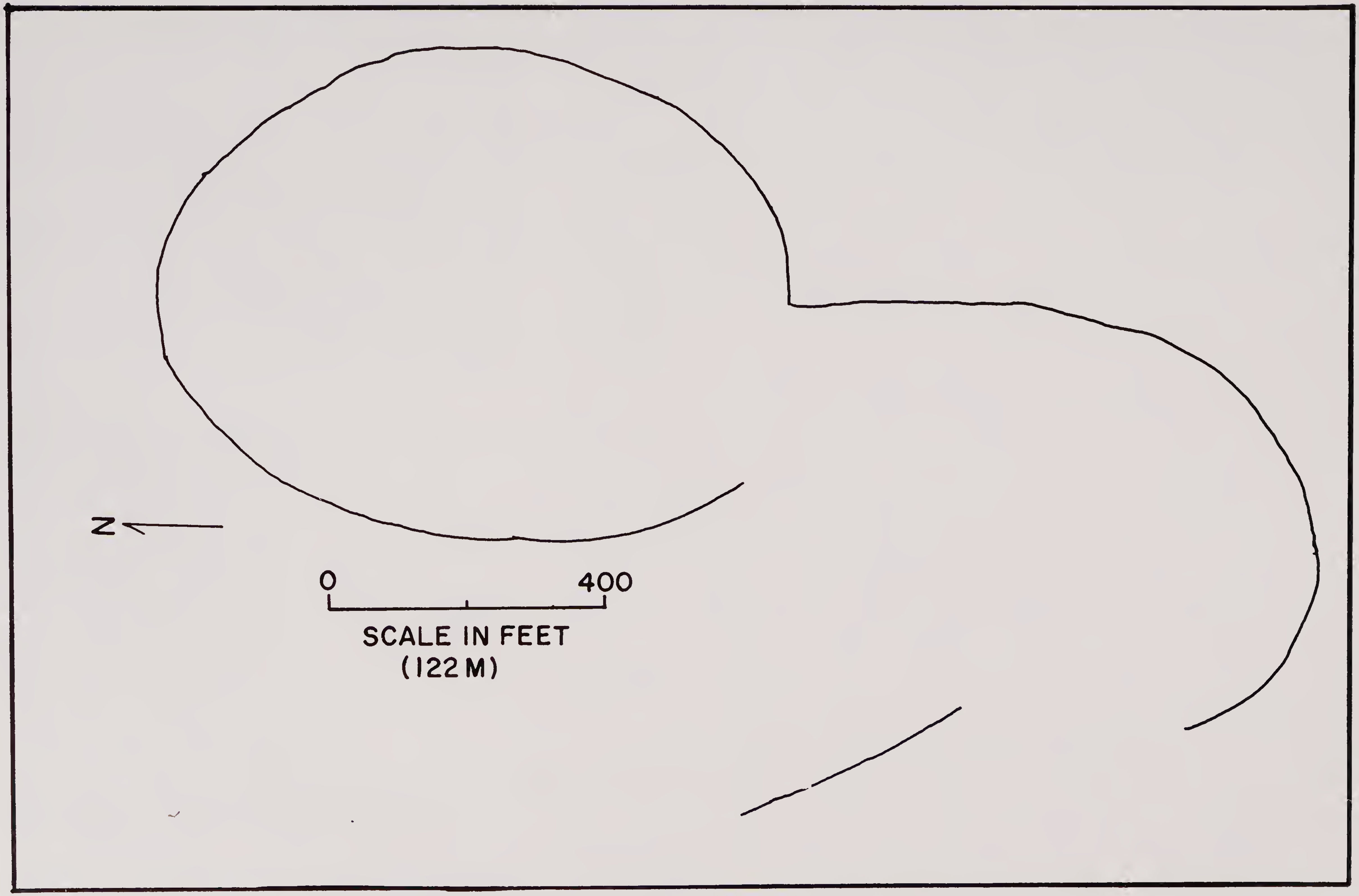


FIGURE 6.1. Schematic diagram of the Fort Bridger antelope trap.

Remains of one aboriginal antelope trap are still visible in southwestern Wyoming close to the town of Fort Bridger. The trap is located in a faulted area characterized by alternating hogback ridges and narrow, flat valleys. Playa lakes are a common feature here in flat areas and are favorite places for antelope to gather, especially after late summer and fall rains. The Fort Bridger antelope trap is strategically located between two of these playa lakes.

The entire trap complex covers an area about 1700 feet long and 700 feet wide, about 27 acres. The corral is oval in shape, roughly 900 × 700 feet. One end of the oval is open and a long, curving fence forms a wing about 1300 feet in length (Figure 6.1). The fence was constructed of juniper. According to local people the fence was originally several feet high. Unfortunately, it was an excellent source of firewood and much of it was removed for that purpose, although enough was left for the outline of the trap to be traced. A few better-preserved sections of the fence suggest that it was around 4 to 5 feet high and about 3 feet wide at the base. Junipers are plentiful (see Figure 6.2) in the immediate site area and enough dead trees would have normally been available for the construction of the trap. The procurement complex was entirely adequate to trap and contain antelope, but it would have been worthless for either bison or deer. The former would have simply gone through the juniper fence and the latter would have gone over it.

Operation of the trap was straightforward. Antelope would naturally congregate at the playa lake, especially after late summer and fall rains regenerated the vegetation. When a herd of sufficient size gathered, the hunters headed it down-valley, which is the natural way it would move if disturbed. When the animals came up against the curved wing, they followed it until they came into the oval enclosure. The animals were, of course, being urged on all the time by persons stationed in the proper locations.

Once inside the oval, the animals were kept circling close to the fence until they were exhausted—an easy task since the animals would refuse to jump the fence and the hunters could take turns chasing the animals from inside where they had the advantage of following a much shorter path than the animals. A possible shaman's structure was present on the north end of the oval but it was too badly deteriorated for us to determine its exact configuration. Animals could have been shot and killed or simply run until they fell from exhaustion.

The age of the trap is not known. Tree-ring studies might have yielded some information had the trees not been removed for firewood. The country is arid and juniper lasts for some time so a date of over 100 years seems reasonable. A similar trap located in the same general area was made of sagebrush and very little of it remains. At least one early resident of the area was reported to have made the claim that he had seen the latter trap in operation sometime before the turn of the century. Details of the operation were not elaborated on but the fact that it was a functional antelope trap in historic times seems certain.

Indirect evidence of antelope trapping was discovered in the Upper Green River Basin near Eden, Wyoming (Frison 1971b). The site (the Eden–Farson site) consisted of a number of lodge sites in open sagebrush-covered country. Parts

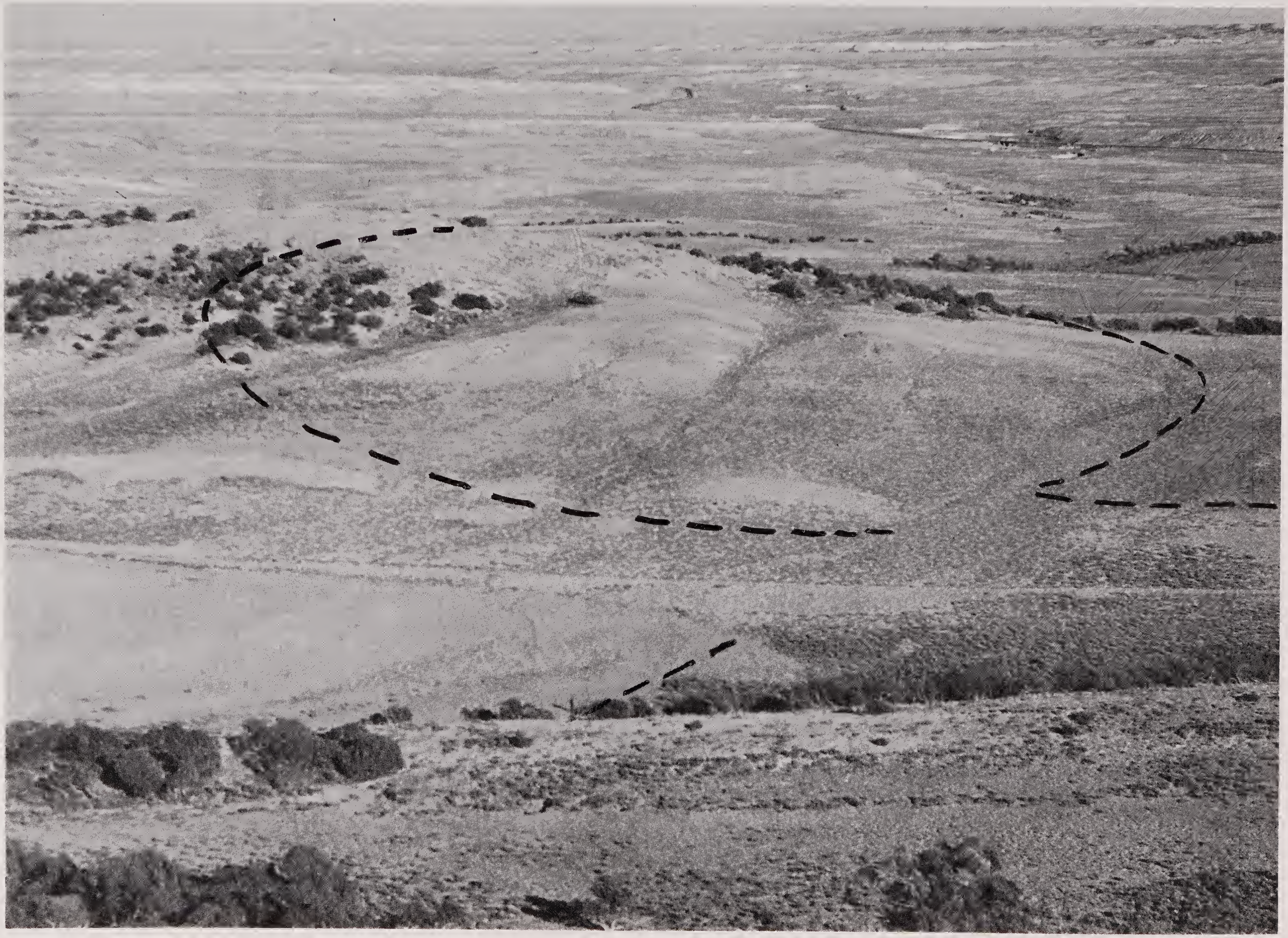


FIGURE 6.2. Panoramic view of the location of the corral at the Fort Bridger antelope trap. The remainder of the wing extends to the right.

of at least 212 antelope were found distributed among the lodges. All the antelope had been killed in late October or early November (Nimmo 1971). The existence of a trap was postulated on the grounds that only a trap could have enabled a small group of hunters to take so many animals in such a short time. Of the several ways the animals could have been trapped, one seems more feasible than the others. The site area is characterized by ridges of sand 20 to 25 feet across and several hundred yards long, presently stabilized by big sagebrush up to 6 feet high. The sand ridges form many almost complete outlines for suitable corrals and the hunters could easily have constructed a sagebrush fence by cutting the shrubs and stacking them. We know from eyewitness accounts that sagebrush corrals are sufficient for holding antelope.

The site is believed to be of Shoshonean origin. Flat-bottomed, flanged-based ceramics, which are a diagnostic horizon marker, were recovered. An age of probably 200 years or more is suggested by a radiocarbon date of 230 B.P. ± 100 (RL–101). No historic items were recovered although an unfinished steatite elbow pipe was of a European style. However, all the site activities were accomplished with stone and bone tools.

Antelope butchering was a stylized process that paralleled bison butchering in some respects (Frison 1971b). Muscles were stripped but instead of cutting off tuberosities and muscle attachments as was done on bison, the hunters usually crushed or chopped off the entire end of a bone. Skulls were removed by cutting directly backward from the rear corners of the mouth through hide and muscle. The mandible was unhinged by a downward pull. Neck muscles were cut and the skull was removed with a quick twist. All bones were crushed and broken and probably cooked in pottery vessels to obtain bone grease. A good share of the meat was probably dried at a separate location, since very few of the parts of bone broken off during butchering to use as handholds for muscle stripping were present at the site.

The number of antelope killed at the site sounds impressive but the animals are not large. A male weighing 80 to 85 lb completely dressed is one of good size; a fawn in the fall of the year weighs on the order of 30 lb. The 212 antelope would have produced at least 6000 lb of flesh in addition to parts such as heart, liver, brains, and bone grease. If we add at least one bison, several rodents, insects, and plant foods that were found at the site there was more food than the group (estimated at about 75) could have eaten before spoilage. We can thus conclude that some of the meat was probably dried and saved for later use.

Two other sites similar to the Eden–Farson site are known in the same general area, which suggests that antelope trapping was part of an ongoing cultural system during the terminal Late Prehistoric or protohistoric period. We have no site evidence for any greater time depth for communal antelope trapping, although it is difficult to believe that it was not a common practice during earlier periods.

Another antelope trap is located in northeastern Wyoming on the headwaters of the Little Missouri River. There were long lines of juniper fence similar to that described for the antelope trap neart Fort Bridger, but the total outline is lacking, again because the fence was used for firewood. It does appear, however, that long fences were placed to bring the animals into a V with some kind of corral at the end. Residents of the area, citing stories told by early settlers, say it was an antelope trap. There seems no reason to doubt its original function. It is out of the area of Shoshonean influence and could possibly have Crow, Sioux, Cheyenne or other Indian origins.

Antelope remains appear regularly in archeological sites from Paleo-Indian to historic times on the Northwestern Plains but seldom in a quantity that would suggest large communal trapping operations until almost into the historic period. It is possible that antelope trapping was carried out in such a way that the evidence was not preserved. It is difficult to accept that once bison were trapped in corrals the same technique would not have been applied to the pronghorn.

Considering the paucity of large quantities of prehistoric antelope remains in archeological sites, I believe the Lost Terrace site (24CH68) on the Upper Missouri River to be an important one (Davis 1976:44). Although slightly out of the area of coverage for this book, it should be mentioned because only antelope are reported in the site. As many as 40 animals, all of which had been butchered, were represented in the part of the site that was investigated. The site was found as the result of a survey to evaluate cultural resources on a stretch of the Missouri River. Cultural affiliations of the site are Avonlea and a radiocarbon date on charcoal is 1045 B.P. ± 80, or A.D. 980 ± 90 (I–9048), which adds some time depth to pronghorn procurement on the Northern Plains. The animals appear to have been killed within a short period, which strongly suggests a trapping situation. The trapping is believed to have taken place in midwinter. Pictograph Cave near Billings, Montana (Mulloy 1958), reflects a continual use of antelope beginning with the Middle Plains Archaic period and on through the Late Plains Archaic and Late Prehistoric periods but not in large numbers.

MOUNTAIN SHEEP

The mountain sheep is not a Plains animal but is indigenous to certain areas of rough country in intermontane basins and for some distance from the mountain fronts. As an example, I observed two large skulls that were washed out of alluvial deposits near Broadus, Montana, a considerable distance from traditional mountain sheep territory. Mountain sheep remains from prehistoric contexts appear all over the Bighorn Basin, as well as in the surrounding mountains. Like the antelope, they very nearly became extinct in historic times, but small resident herds survived in the Absaroka and Bighorn mountain areas and formed a basis for a number of viable herds. Mountain sheep find survival difficult, primarily because of parasites introduced by domestic sheep but also because of shrinking natural habitats.

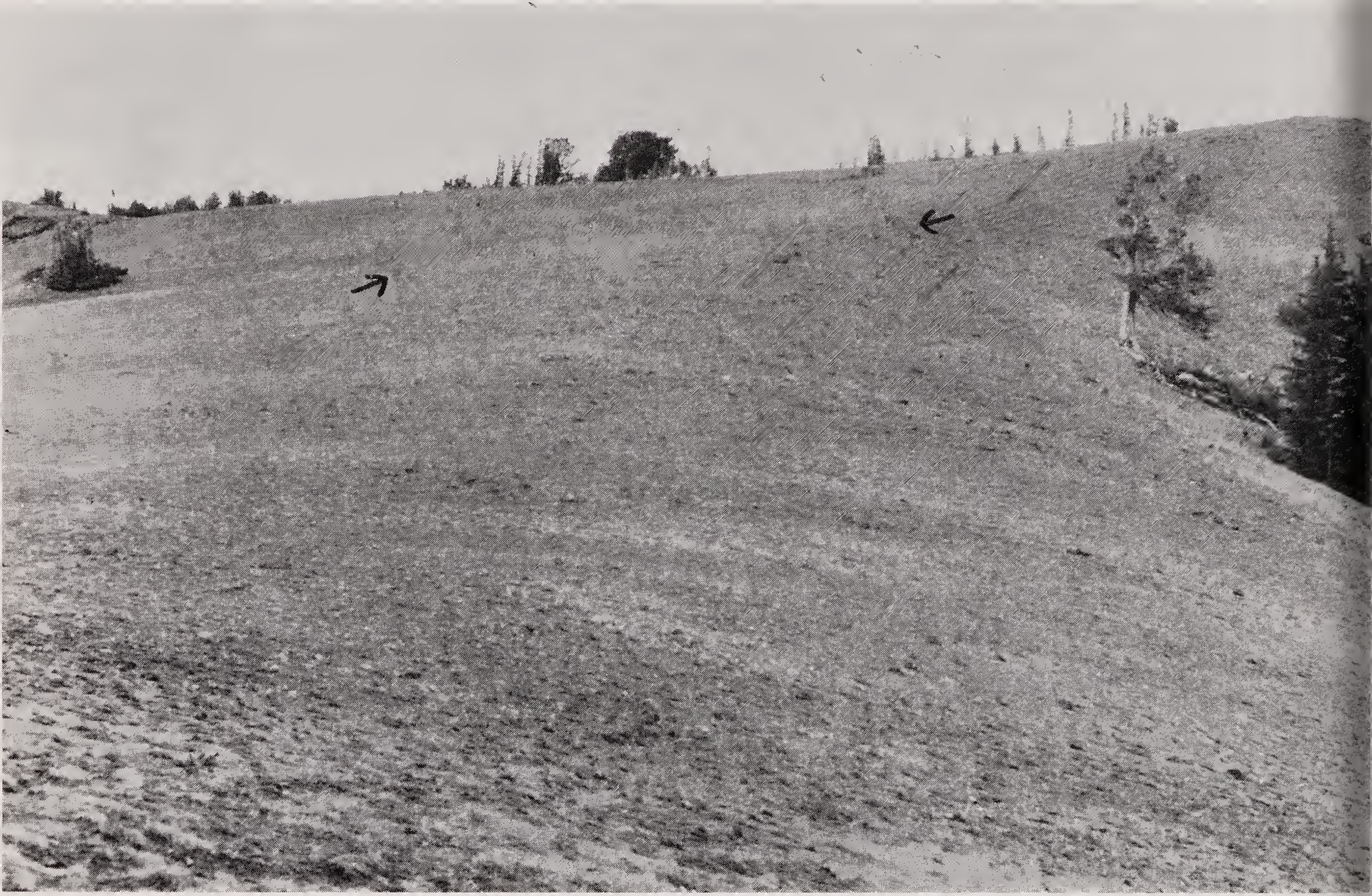


FIGURE 6.3. Converging drive lanes of stone at the Boulder Ridge animal trap indicated by arrows.

Mountain sheep today are found at the higher altitudes usually in or close to rough country. They can negotiate high, perpendicular walls, going either up or down with unbelievable ease. With hunting pressure they became wild and extremely wary. Although usually pictured as inhabiting the high, rough, treeless area above the timberline, they are not entirely adverse to thick timber. Nursery herds are separate from the rams except during the rut. Probably the most rewarding way to hunt mountain sheep is to spend enough time observing them to learn where the animals are located and something of their daily habits without alerting them to one's presence. In this way they can be successfully stalked. Going after mountain sheep without being aware of their exact location gives the animal all the advantages of seeing and hearing the hunter from superior vantage points.

Evidence consisting of stone cairns, lines of stones or lines of stone piles, horseshoe-shaped structures, and occasionally remnants of wooden logs and

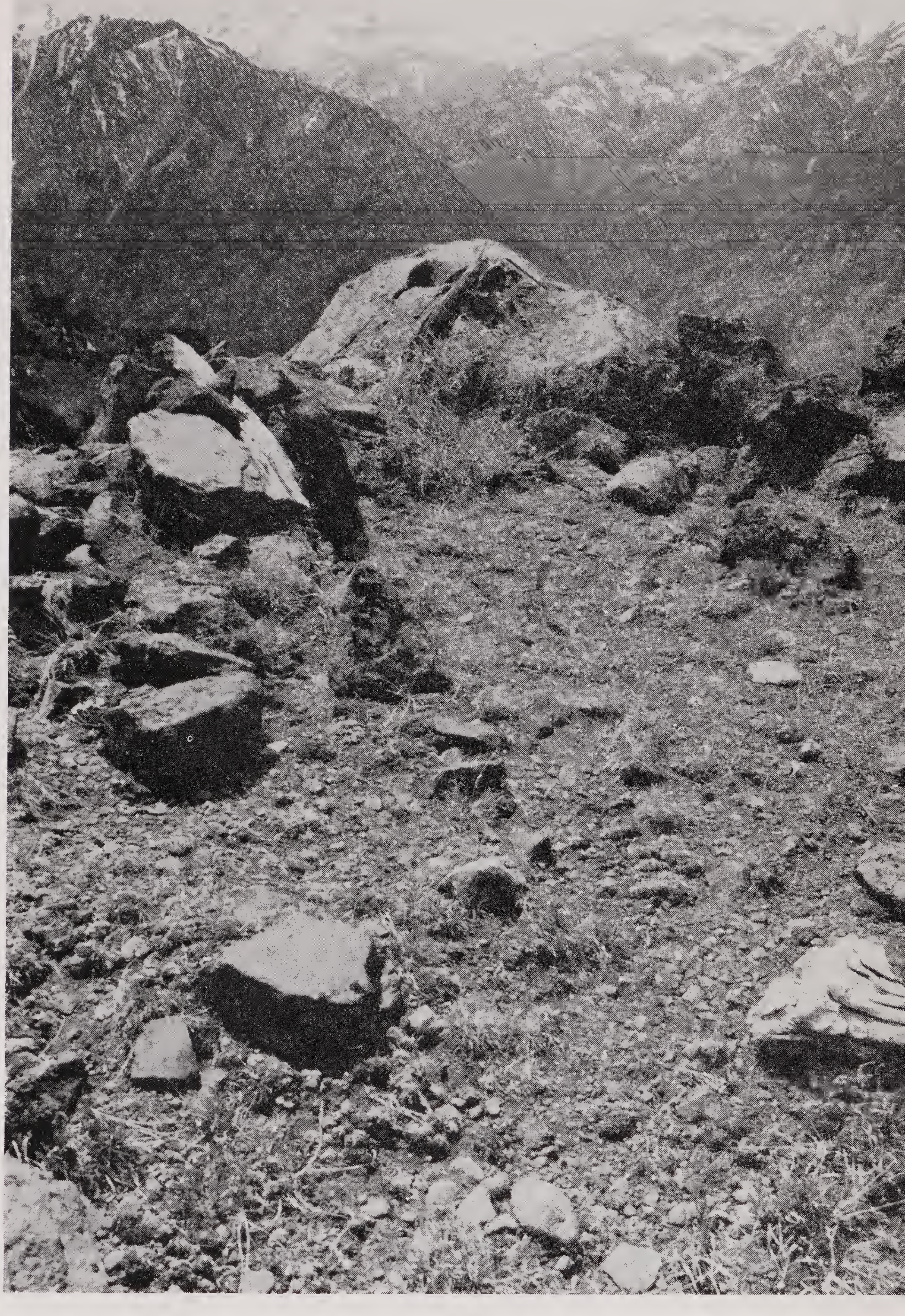


FIGURE 6.4. Remains of horseshoe-shaped structure at the Boulder Ridge animal trap.

stumps (preserved because of a high content of pitch) suggests prehistoric remains of mountain sheep procurement complexes. The procurement process is not fully understood; although the drive complexes seem feasible, the final trapping situations have not yet been satisfactorily explained. One example is the Boulder Ridge sheep trap, a complex of drive lines that begins at the timberline (about 10,000 feet elevation) and extends above the timberline in the Absaroka Mountains on a high divide east of the South Fork of the Shoshone River. The site is close to the center of an extensive area of high, bare ridges and deep stream valleys. Here discontinuous lines of stone were strategically placed for nearly a mile (Figure 6.3) so that animals were finally funneled into

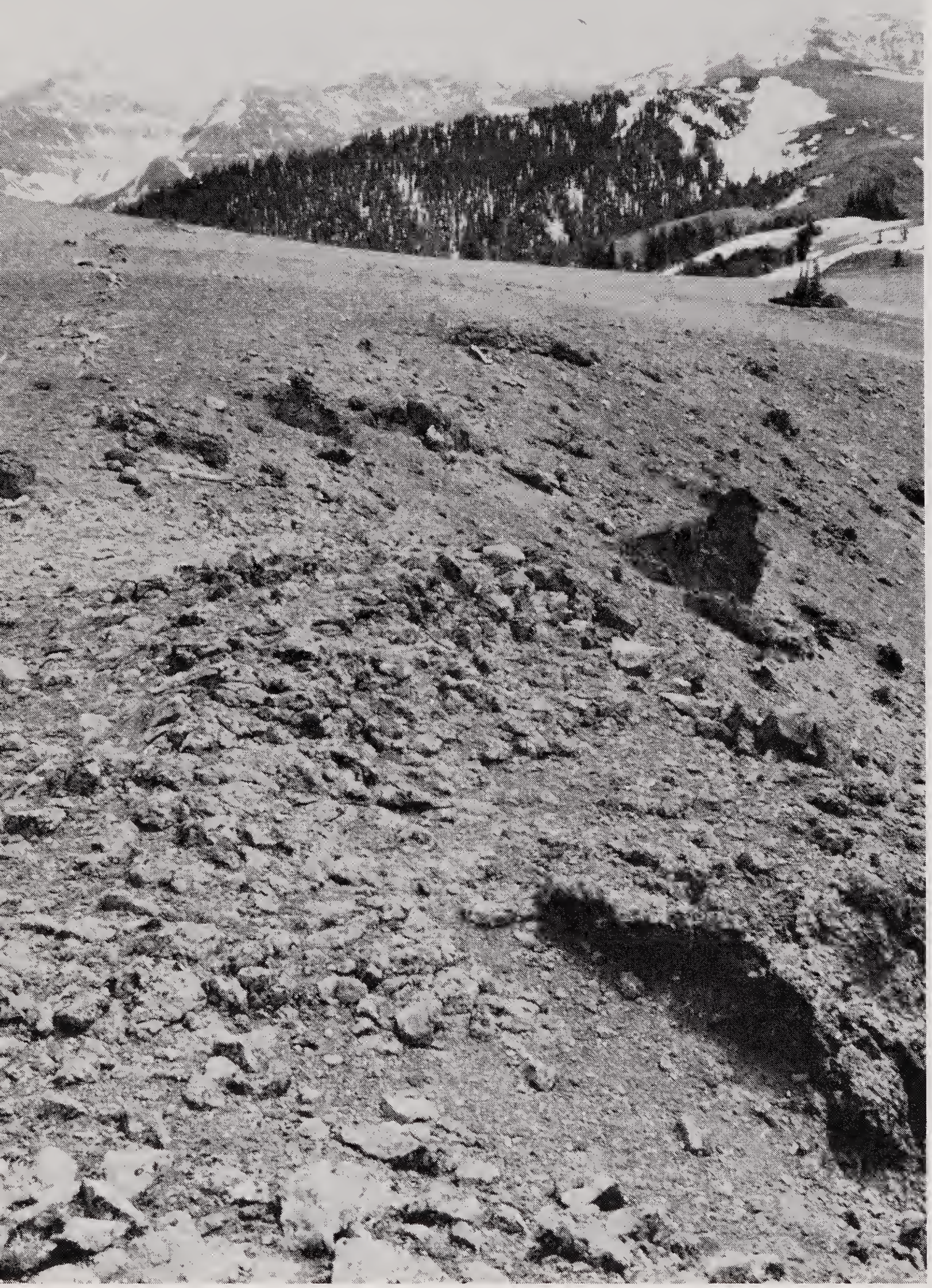


FIGURE 6.5. Terminus of the Boulder Ridge animal trap.

two converging lines of stones. Horseshoe-shaped stone piles (Figure 6.4) were placed on high points and with the addition of a small brush superstructure would have hidden a man inside. They are strategically placed, probably to enable the hunters to kill any animals that tried to slip away from the main group. The end of the converging lines of stones is on a flat at the top of a steep talus slope (Figure 6.5). It is possible that the talus slope served to slow the animals sufficiently so that they could have been killed, but there is no entirely satisfactory evidence for this.

This particular drive line complex satisfies the requirements for bringing mountain sheep for a considerable distance and pushing them over a steep talus slope. The latter would have been lethal to bison but no great problem to mountain sheep. The possibility of a holding pen at the bottom cannot be ruled out either; it may have simply disintegrated through time. Some remnants of pine stumps remain in the lines of stones toward their terminus but these are large, badly weathered, and now almost solid pitch. At this elevation they could be several hundred years old. The appearance of the entire complex also suggests an age of several hundred years. If this is so, it provides evidence for some time depth for communal mountain sheep trapping at and above the

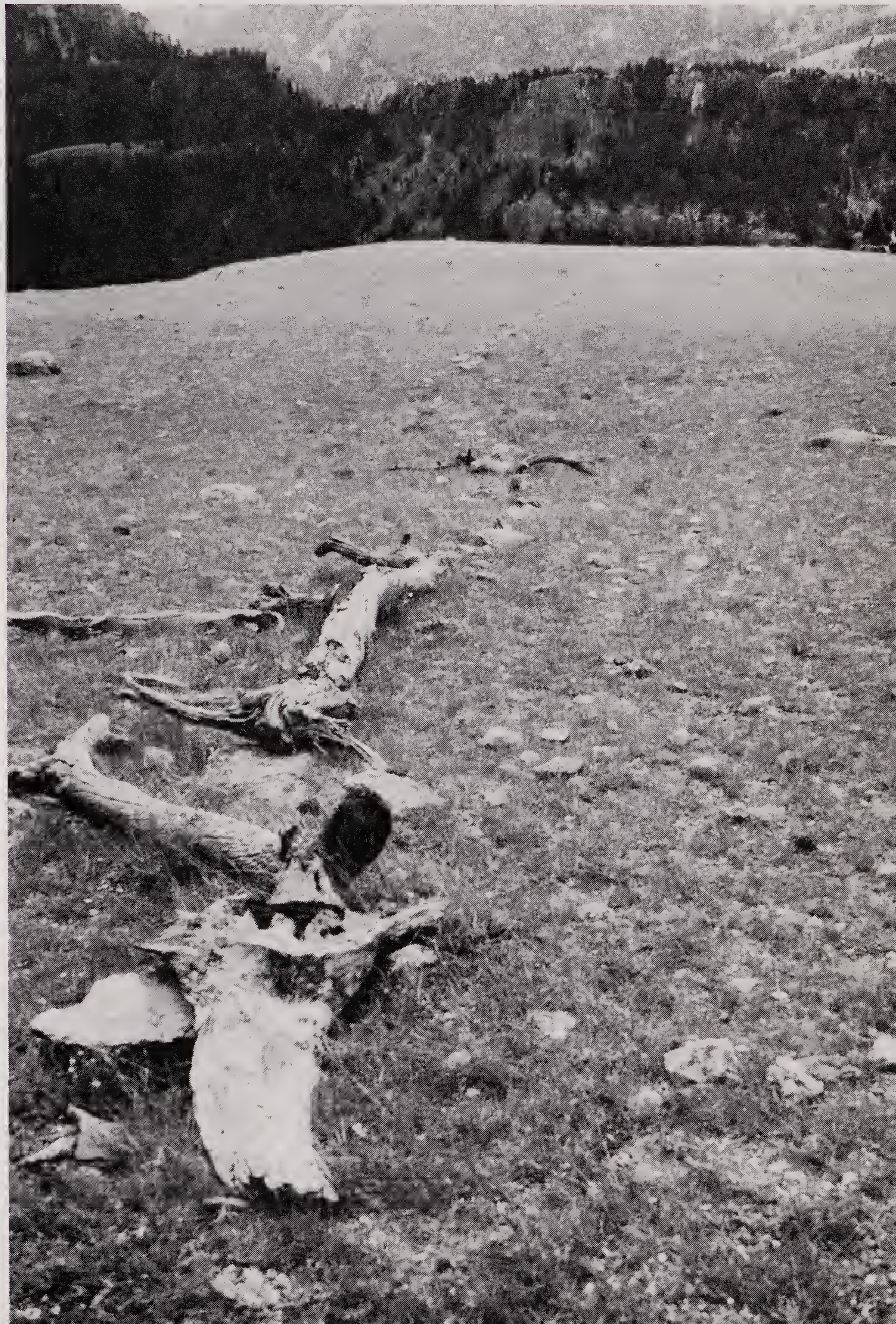


FIGURE 6.6. Stone and wooden parts of the drive lines at the Dubois animal trap.

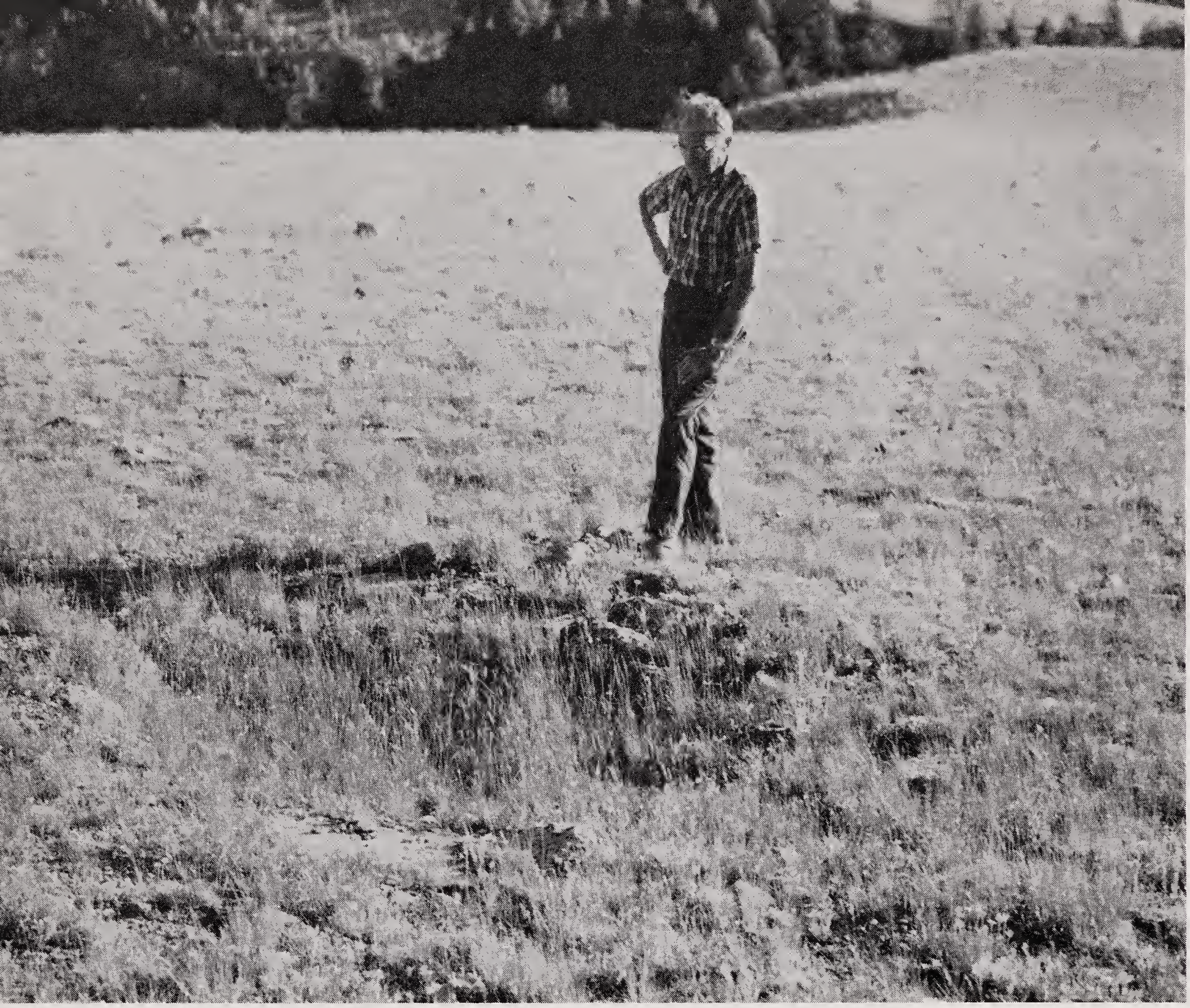


FIGURE 6.7. Pit located at the start of the drive lines at the Dubois animal trap.

timberline. In addition to such drive line complexes, there are innumerable single manifestations of stone cairns throughout the high country that suggest hiding places for hunters lying in wait in strategic spots for mountain sheep.

A drive line complex similar to that just described was found at the Dubois site, about 30 miles south of the Boulder Ridge site. In this case the V of the drive lines terminates at a perpendicular bluff about 30 feet high. There is, however, a narrow shelf about halfway to the bottom that mountain sheep could use effectively to go over the precipice without incident. If the site was a mountain sheep jump, it must have had some sort of holding structure or some other means of containment at the bottom.

The drive lines here (Figure 6.6) contain some badly weathered pitch logs. At the beginning of one line there are two artificial pits that are large enough to contain a man (Figure 6.7). As with the Boulder Ridge drive lines, these appear to be of considerable age. There is evidence that the same cliff may have been used as a buffalo jump. This is based on historical accounts of bison remains at the base of the cliff, since no bison remains are there at present. If the cliff was a bison jump, it must have been used comparatively recently. The complex appears similar to the Boulder Ridge game drive complex but is about 8000 feet in elevation. I do not believe that the complex was first constructed and used as a bison jump.

There is unequivocal evidence for the occurrence of communal mountain sheep trapping at probably about the beginning of the proto-historic period but

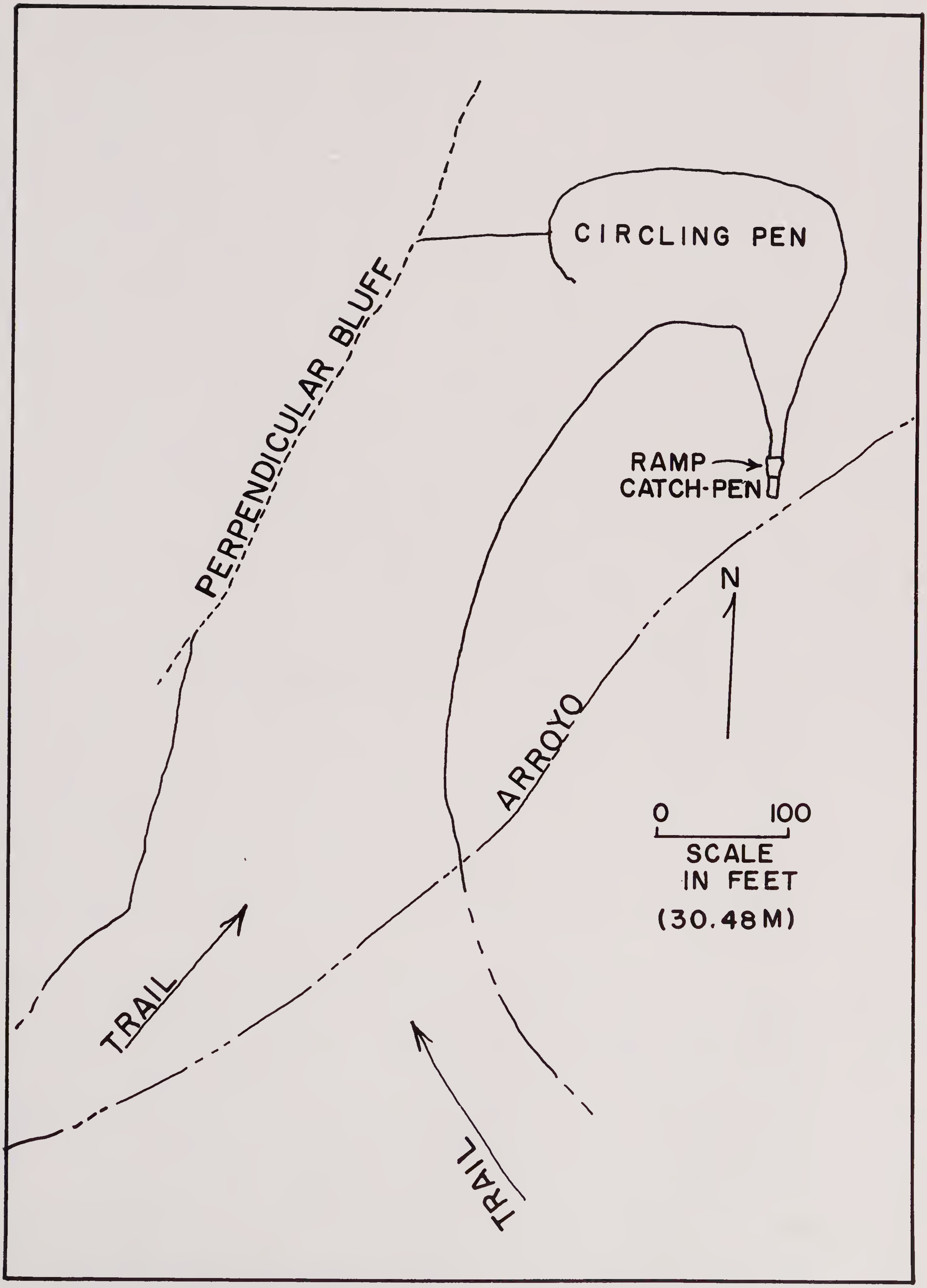


FIGURE 6.8. Schematic diagram of a mountain sheep trap.

the procurement complexes are entirely different in principle than the ones just described. These are located in the same general area as the drive complex—about 30 miles south of the Boulder Ridge site—and are known as the Wiggins Fork Mountain Sheep Traps. They are located on a high divide atop a steep scarp that extends for several miles along the east side of the Wiggins Fork River, a tributary of the Wind River. Three traps are presently known. Two are at an elevation of about 8500 feet and the third is at about 8000 feet.

The three traps are basically similar. (Two are diagrammed in Figures 6.8 and 6.9.) They are manifest by fences constructed of dead timber, of which more is plentiful today. Wings were used to funnel the animals into a round or oval corral and converging fences extending from one side of the corral led to narrow chutes (Figure 6.10), then to a ramp that terminated in a catch-pen (Figures 6.11 and 6.12). The fences were originally high and leaned inward (Figure 6.13) to prevent the animals from jumping over them. The catch-pens are long and narrow; one is about 6 × 20 feet whereas another is about 6 × 13 feet. Much of the smaller brush and poles has rotted away but the fences in the corral, chutes, and catch-pens must have been somewhere between 8 and 10 feet high. Mountain sheep can negotiate a fence over 10 feet high if they can get enough room to run so that they can hit the fence partway up and use their momentum to carry them up over the top. However, the inward angle of the fence would prevent them from doing this.

The traps are located strategically for these kinds of traps and trapping situations in relation to present-day mountain sheep bedground locations, which probably have not changed. The animals were probably funneled into the oval pen, where they were kept circling—much the same as antelope were circled. As long as they were kept circling, they were under some measure of control by the hunters. Animals were dodged off into the V-shaped chute and up the ramp that hid the catch-pen, and the animals had no place to go but into it. One of the traps (Figure 6.12) utilized a large rock instead of a ramp. Logs and rocks were piled on top of the rock to increase its height. Mountain sheep bones were found at this catch-pen, leaving little doubt of its true function. Both nursery herds and ram groups may have been taken, but probably not at the same time.

The traps are all situated so as to take advantage of the mountain sheep's natural movements when disturbed. Remains of small structures large enough to hide a single hunter are critically situated to prevent animals from escaping. Some of these were aboveground, but others were pits in slide rock that had been covered with a small superstructure. None of the superstructures are complete but some of the poles used in construction are still present. The chute and catch-pens are oriented toward the general direction of the animals' bedgrounds which may have caused them to enter the chute more easily.

Two of the traps are in the timber but one (Figure 6.14) is in open country. There is no evidence of steel axe use on any of the timbers used to build the traps. Fences and catch-pens are well designed (Figure 6.13) and represent a good deal of effort. Mountain sheep are not large compared to bison, but they can destroy a poorly constructed fence if cornered.

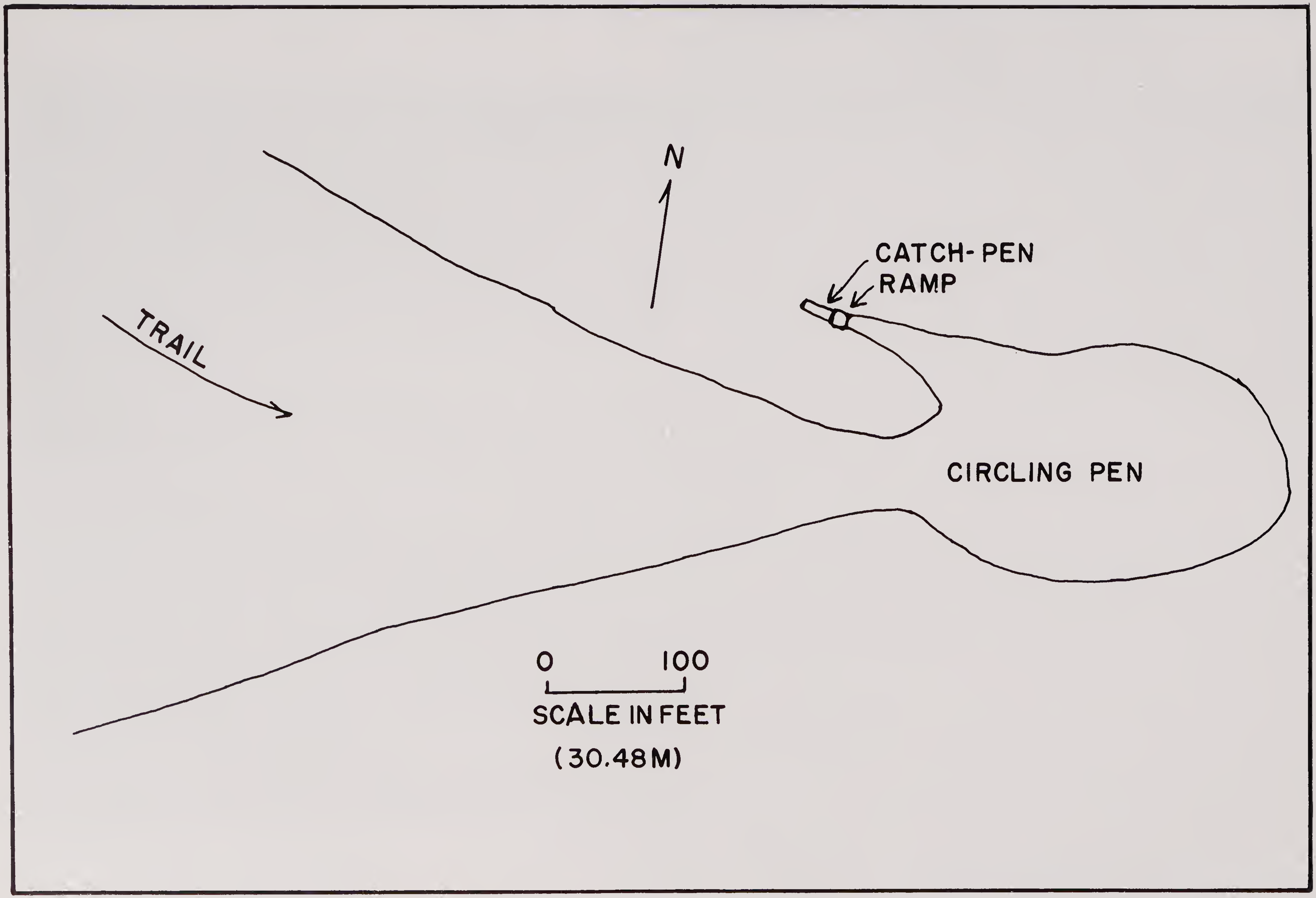


FIGURE 6.9. Schematic diagram of a mountain sheep trap.

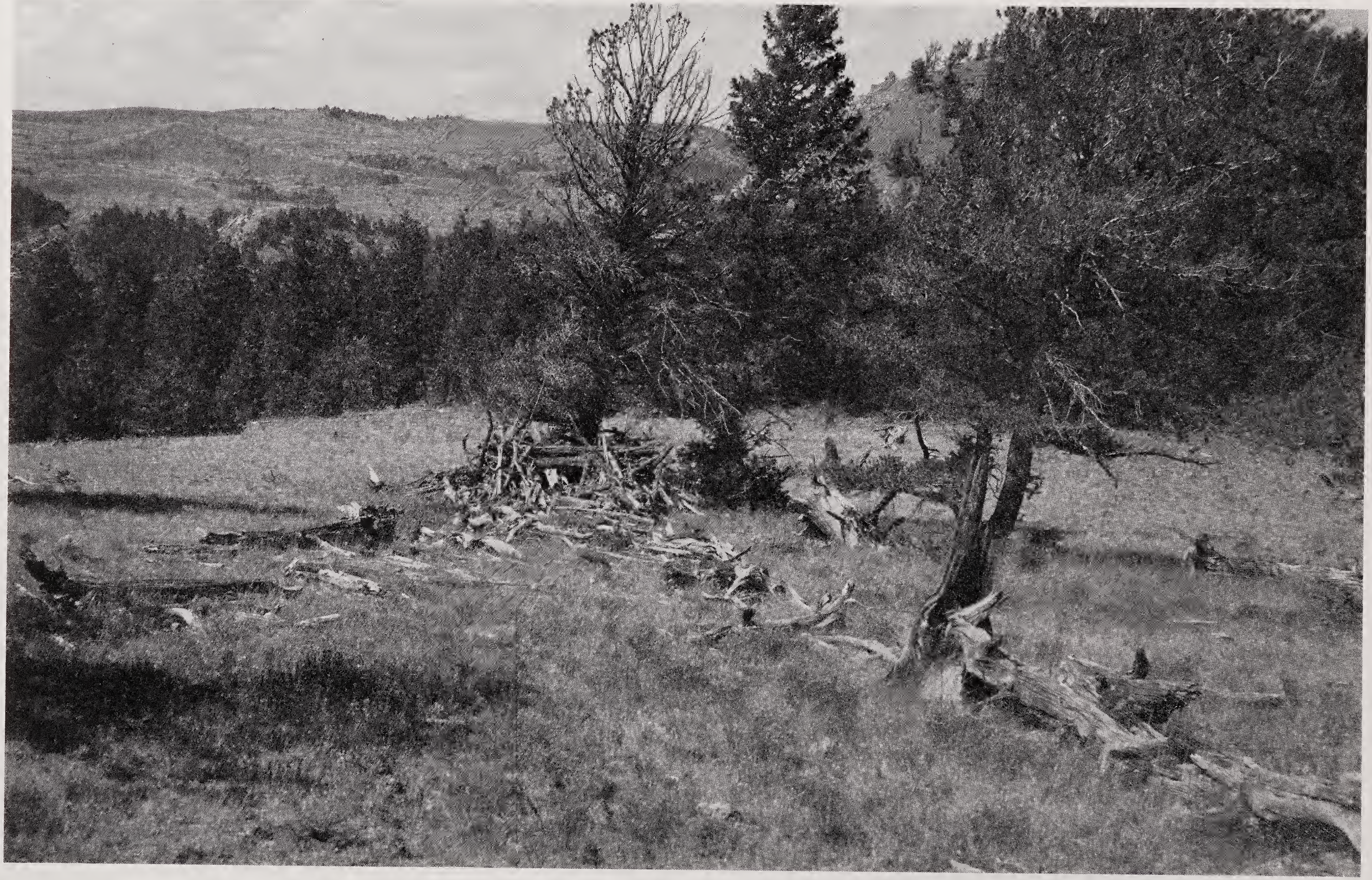


FIGURE 6.10. The V-shaped fence, ramp, and catch-pen of the mountain sheep trap in Figure 6.9.

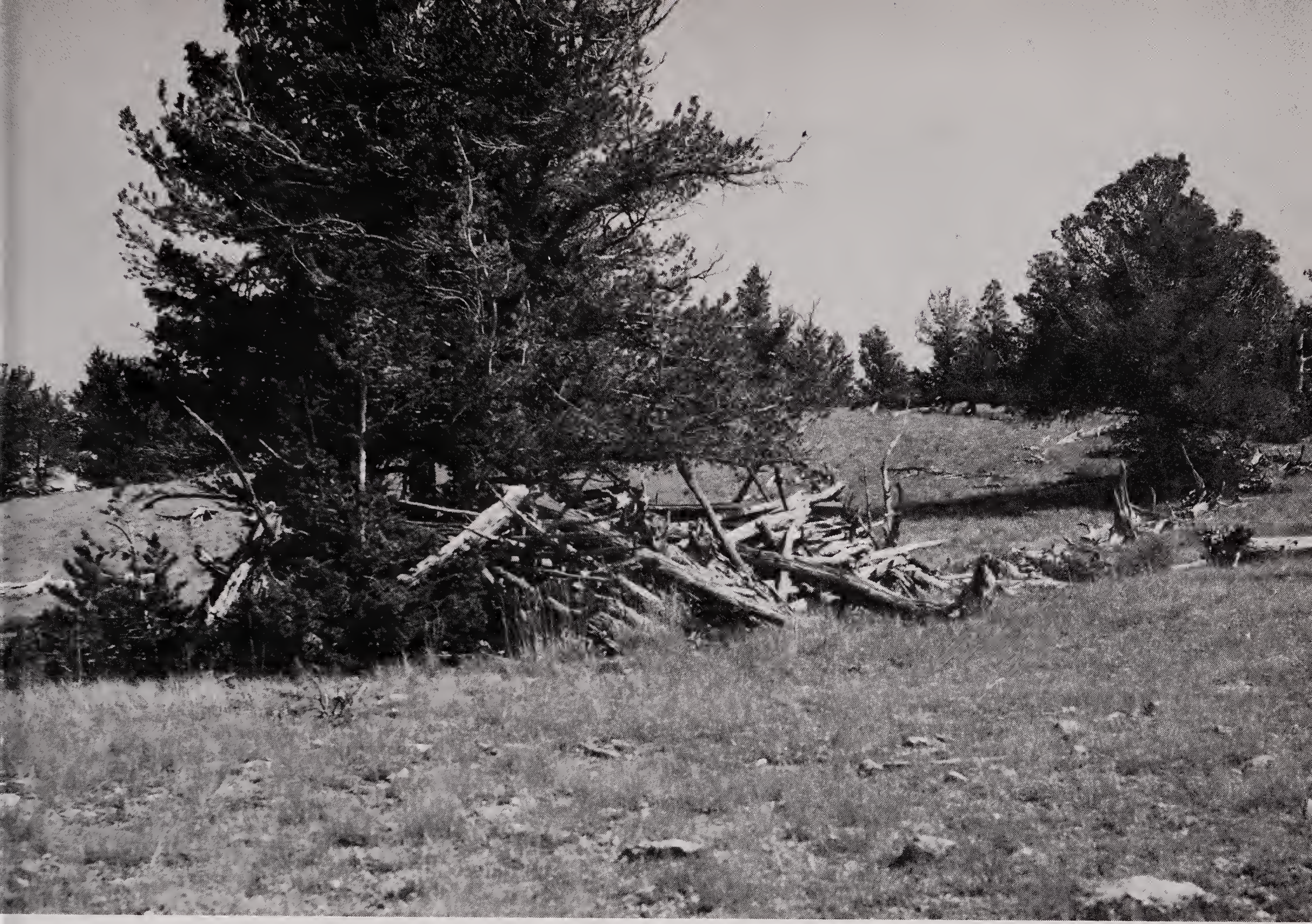


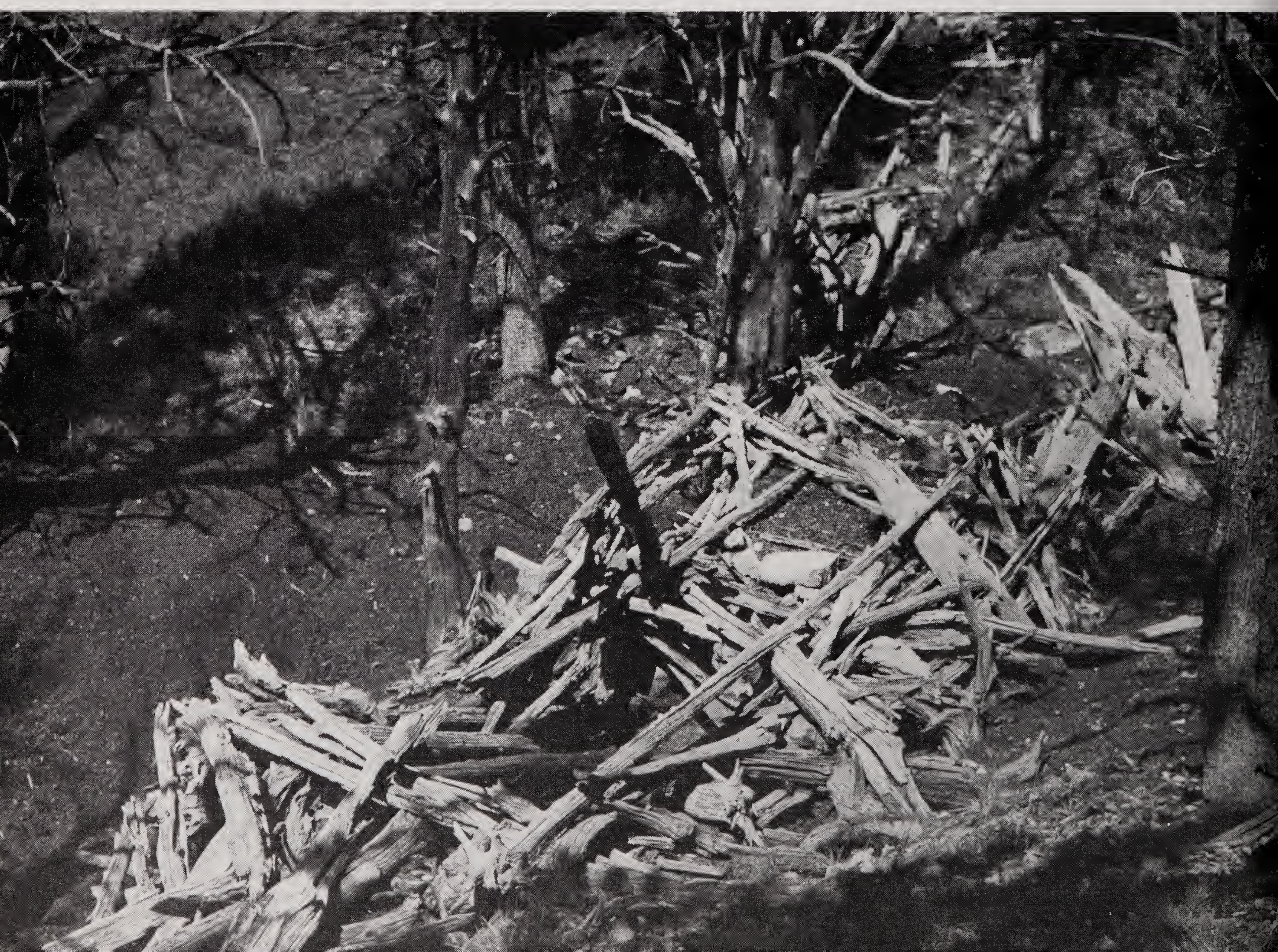
FIGURE 6.11. A different view of the fence, ramp, and catch-pen of the mountain sheep trap shown in Figures 6.9 and 6.10.

It is believed these traps are at least 100 years old and probably of Shoshonean origin. The construction of the catch-pens looks very much like that employed in dome-shaped log-and-brush habitation lodges scattered over the high country of the area; these have been attributed to the Shoshoneans (Figure 6.15). In fact, a catch-pen for a mountain sheep trap in the Absarokas close to the western boundary of Yellowstone National Park was once considered an elongate house structure, since the fences had nearly all rotted away. After the discovery of the complete trap, the true nature of the elongate structure was immediately apparent even though the timbers were joined at the corners in a manner similar to that of lodges. I have a strong feeling that they are in some ways indicative of an antelope trapping pattern applied to mountain sheep. The idea of the circling pen seems foreign to the high country and may have been an innovation by Shoshonean groups who were forced out of their normal economic activities by white expansion. They subsequently attempted an intensive mountain sheep procurement orientation that was probably successful but short-lived since the number of animals critical for communal procurement was soon trapped out of existence.

A trap complex that seems to have a strong resemblance to those just described is located in the Beaverhead National Forest in southwestern Montana (Keyser 1974). There are, however, some fundamental differences in construction. The Montana complex apparently lacks the circling pen but the corral or catch-pen is 7 × 22 feet and is of cribbed log construction, quite similar to the ones in Wyoming. This trap was probably one in which deer were taken. The site is at an elevation of about 8000 feet and in the past it may have been in a mountain sheep habitat area. It is estimated to have been constructed somewhere between 1800 and 1850.

The South Fork of the Shoshone and the Wiggins Fork areas support viable mountain sheep populations today and the traps' feasibility can be tested by observing normal animal behavior patterns. It is likely that mule deer also may have been taken in these traps but as yet we have no evidence. Other high-altitude game drive systems are known from the Colorado Rockies (Benedict 1975).

FIGURE 6.12. Catch-pen of the mountain sheep trap shown in Figure 6.8.



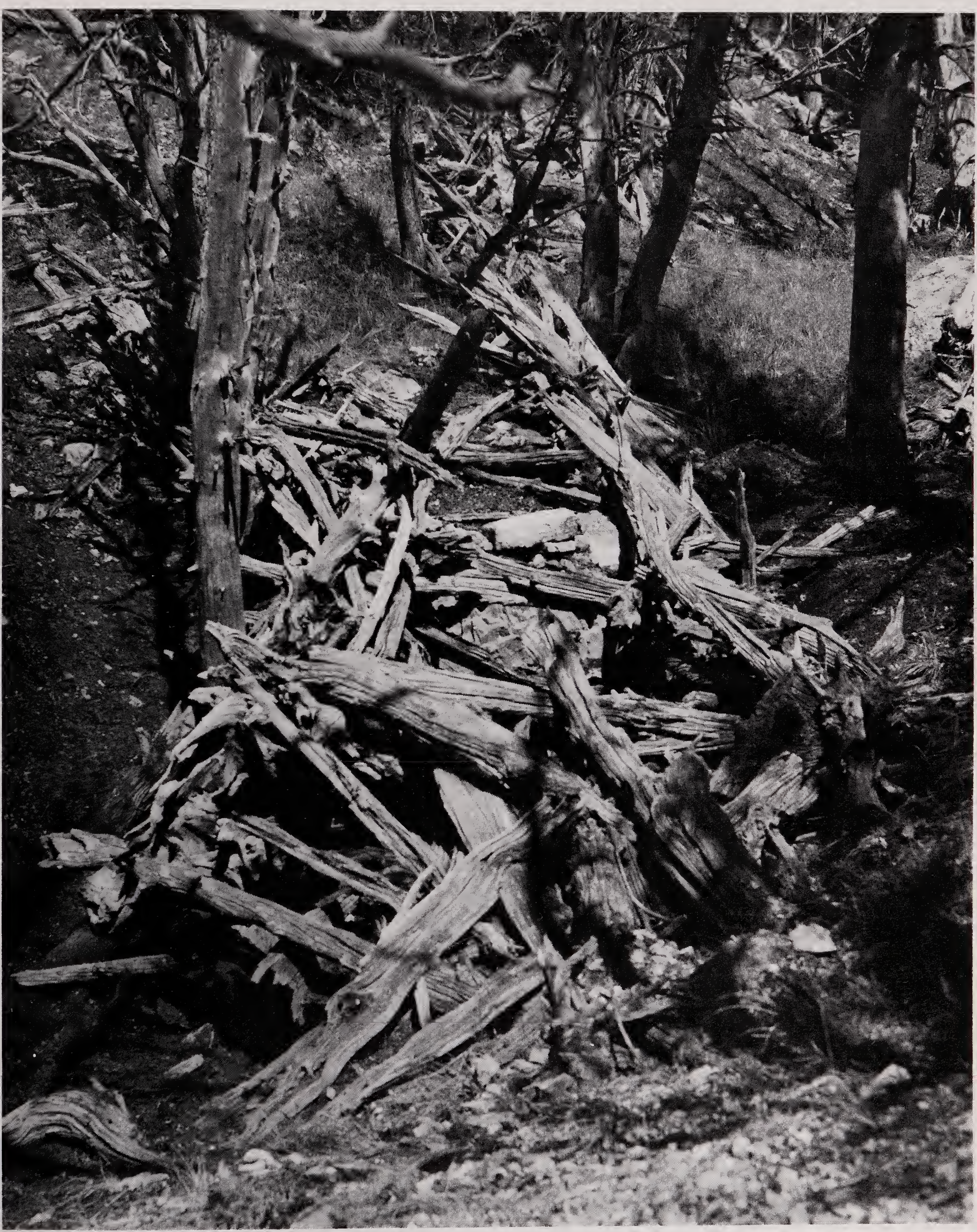


FIGURE 6.13. Catch-pen and fence of the sheep trap shown in Figures 6.8 and 6.12. Note the opening at the bottom, presumably for removing dead animals.

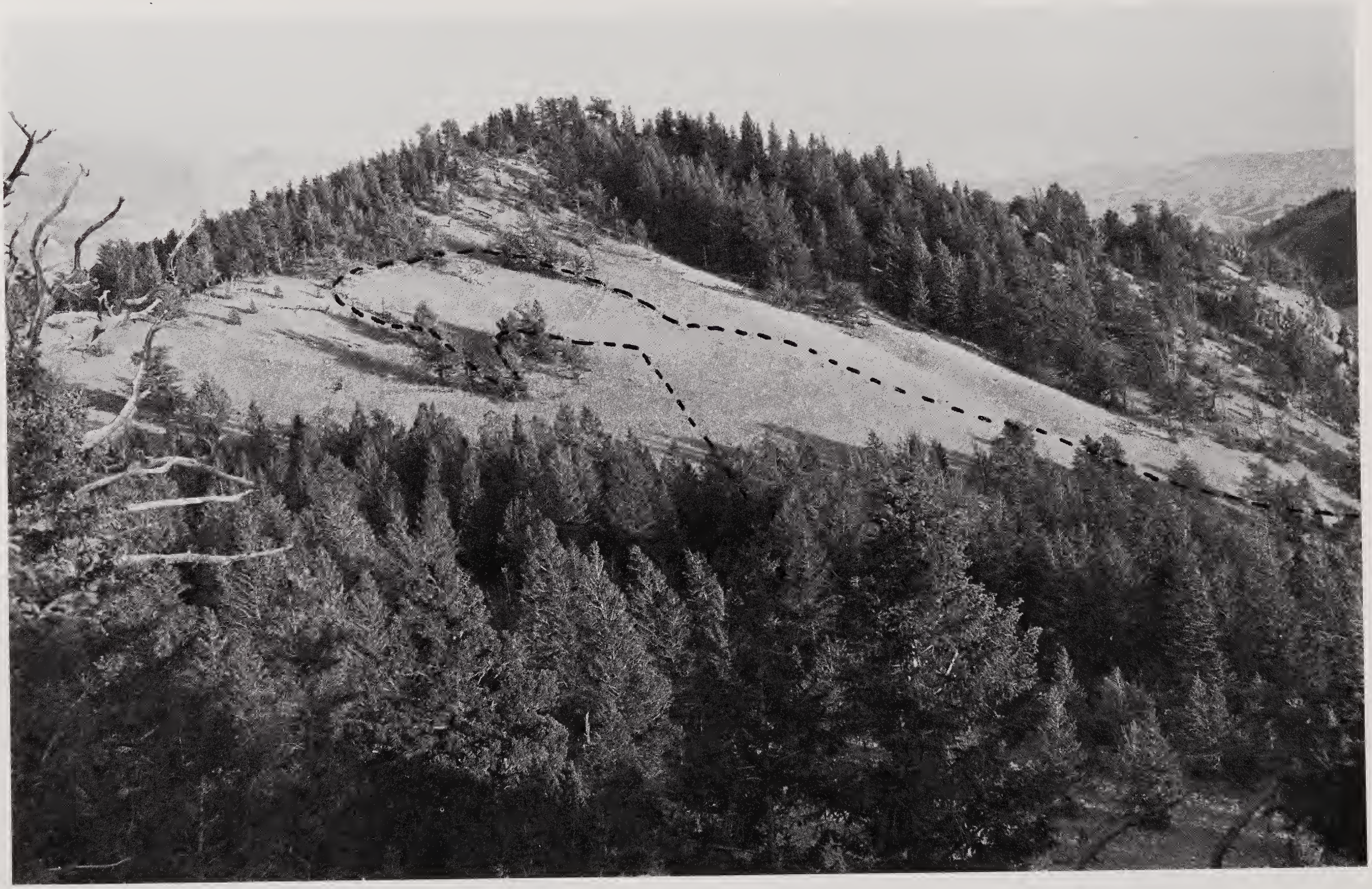


FIGURE 6.14. Panoramic view of the mountain sheep trap shown in Figures 6.9, 6.10, and 6.11. Note drive lines, circling pen, chute, and catch-pen.

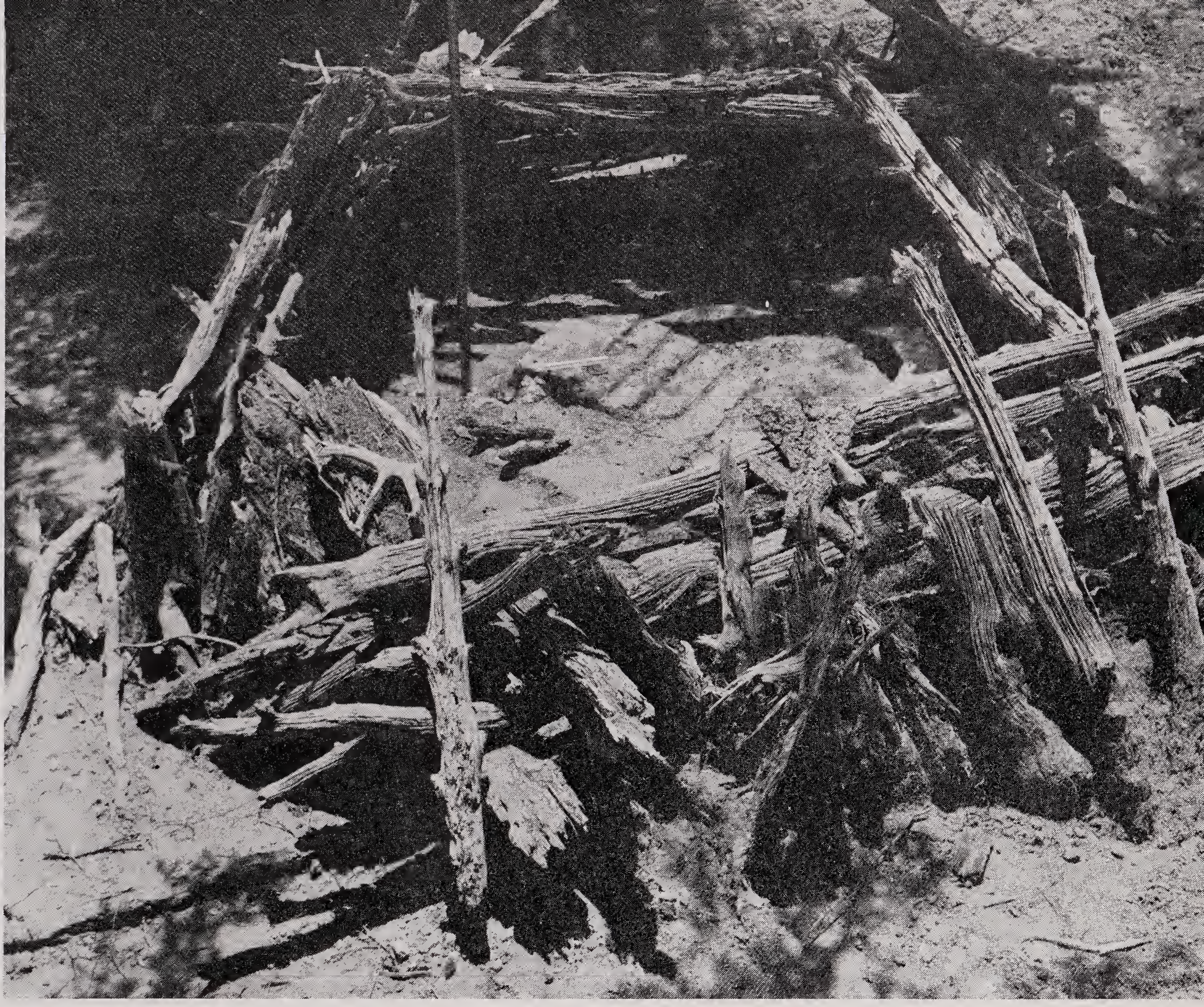


FIGURE 6.15. Habitation structure in the Absaroka Mountains.

DEER

Mule deer remains appear in archeological sites from Folsom to the historic period. There is no known conclusive evidence of either mule or whitetail deer trapping in prehistoric times on the Northwestern Plains even though the faunal evidence in sites indicates that they were continually hunted.

Unlike antelope, mule deer favor rough, brushy country and are not usually in evidence during the day, especially in warm weather. Livestock fences present little problem to normal healthy animals. However, weak animals are prone to putting their hind legs between the top and second wires of fences as they attempt to jump over, with disastrous results. They will also go through or under fences if necessary. Mule deer could have been trapped but individual or small group hunting was probably more rewarding. They are not regarded as difficult to hunt. They usually demonstrate a fatal attribute in their behavior pattern which is to nearly always run a short distance when frightened and then stop to look back. Mule deer are a dependable source of food when they are present in an area.

Evidence that argues strongly for some sort of ceremonialism connected with deer procurement was present at an extensive McKean campsite in northwestern Wyoming. The site, known as the Dead Indian Creek site (48PA551) (Smith 1970), is located in the Sunlight Basin, a small mountain basin in the

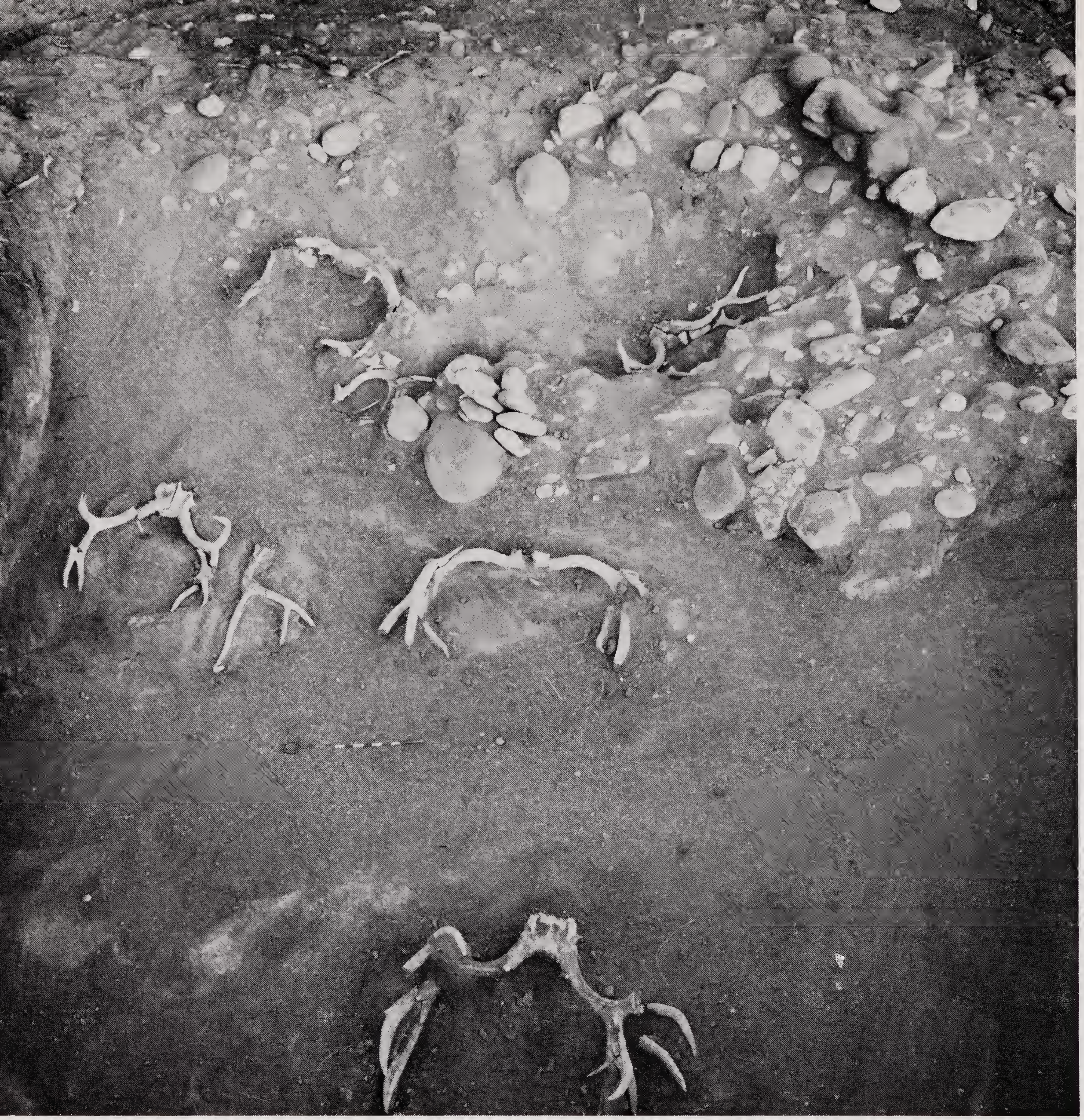


FIGURE 6.16. Deer skullcaps and antlers at the Dead Indian Creek site.

Absaroka Mountains. Deer were taken in considerable numbers during the winter, and several large male skullcaps were given unusual treatment. One was placed in a hole in the center of a rock cairn and others were placed to one side of it (Figure 6.16). At least two of the specimens are large enough to be regarded as trophies today. Stone artifacts of the McKean Complex were directly associated with the skulls and all of this was alongside a large campsite rich in cultural materials.

There are a number of questions concerning the preservation of the skulls. They were covered with alluvium to a depth of just over 2 feet. No evidence indicated that they had been placed in artificial pits, but a strong argument can be made for the covering of the entire feature with alluvium shortly after placement. Porcupine remains were common in the site deposits and are common there today since these animals cannot resist chewing antler. None of the antler material demonstrated more than superficial rodent chewing, so it must have been covered with the alluvium within a short time. Also, the antlers demonstrate no evidence of weathering, which begins to accelerate deterioration after about a year in the open.

The remains of about 50 mule deer were recovered at the site, and only a small part of the site was excavated. Smaller numbers of mountain sheep were present also. Mule deer, especially the mature males, often occupy about the same kind of rough, rimrock country that mountain sheep favor; their behavior is much like that of mountain sheep. Mule deer are not able to negotiate quite the same terrain as mountain sheep but in many ways they run a close second. It is not at all unlikely that a combination mountain sheep and mule deer trap was located somewhere in the extremely rough country surrounding the Dead Indian Creek site.

Whitetail deer are known from the Big Goose Creek site on the eastern slopes of the Bighorn Mountains in a context that produced what are believed to be Crow Indian ceramics dated at about 450 years ago (Frison 1967a). Nearly complete skulls and postcranial parts were recovered in the site and the antlers were used as various kinds of tools and tool hafts. No other whitetail deer remains have been positively identified from archeological sites in the area.

Whitetail deer were not present in the Big Goose Creek area in historic times but were reintroduced early in the twentieth century and now appear to be replacing the mule deer. Whitetail deer behave quite differently than mule deer and favor stream bottoms and brushy areas. In terms of hunting the two species, the whitetails are more difficult. They hide in brushy areas and demonstrate the frustrating trait of keeping trees, brush, and other obstacles between them and the hunter. However, the whitetail deer was a relatively insignificant food source on the Northwestern Plains, according to the archeological record.

As I mentioned before in discussing mountain sheep trapping, both deer and mountain sheep could probably have been taken in the same trap. Keyser (1974) argues for this and supports his argument with evidence that some Shoshone groups were able to trap deer and that the Crow also may have been aware of these kinds of procurement activities.

ELK

The Rocky Mountains today provide habitat for a considerable number of elk but elk rarely appear in archeological sites on the Northwestern Plains until the Late Prehistoric period. Even then they appear in small numbers. One pair of elk mandibles was found in the McKean level at the Dead Indian Creek site, although small tests in a protohistoric level at the same site yielded a large number of elk bones and antler remnants that demonstrate deep grooving marks. A single elk was recorded at Pictograph Cave I (Mulloy 1958:226) at what should be a time period close to that of the Dead Indian Creek site. None were reported in Pictograph II levels but three specimens appeared in Pictograph III and IV (Late Prehistoric and historic) levels. Both the camp and bison kill areas of the Big Goose Creek site provided evidence of elk, especially antlers, which were used for tools and decorative items. Remains of elk were found in the Piney Creek Buffalo Jump (Frison 1967b). Two elk-antler flaking hammers are recorded from Late Prehistoric period Shoshonean sites and several elk antlers were recovered in log structures—(Figure 6.15) also believed to be Shoshonean—located on the eastern slopes of the Absaroka Mountains near Cody, Wyoming. Elk were hunted regularly by Shoshonean groups in historic times (see, for example, Wilson and Driggs 1919). The evidence from archeological sites indicates that the elk was not of much significance on the Northwestern Plains until the Late Prehistoric period. We may, however, have to revise our thinking on prehistoric elk populations in the area because of the large number of elk-antler digging tools recovered in quarry sites of both the Early Plains Archaic period (see Chapter 9, Figure 9.2) and the Late Plains Archaic period (Davis 1973).

Elk are particularly desirable meat animals and they are not difficult to hunt. No evidence is known of artificial elk traps or of communal procurement practices. Elk are able to adapt to a variety of ecological situations. Today viable elk herds are located from low elevations to the timberline. They are at home in rough country, open plains, thick timber, or brushy areas. They can travel long distances at a distinctive gait that appears to be slow but is not. They are gregarious animals and tend to congregate in large herds, but they fragment into smaller groups when they are the subject of heavy hunting pressure. They are also particularly vulnerable to the well-trained hunter. The animals are predictable in their habits and usually easy to locate. Once a bunch is located, it is relatively easy to maneuver into position to kill one.

Elk are easily confused. A mature female is usually the bunch leader and if she is killed the remainder of the herd will often mill in circles and the entire herd or a good share of it can be killed. On the other hand a herd that is frightened can travel for several miles and be difficult to locate.

Elk are characterized by a distinctive odor that can be detected for several hundred feet if the air currents are right. Under hunting pressure they tend to hide in thick timber during the day. A favorite hunting trick is to scout out timber patches carefully, locate the animals by smell, and then run at top speed into the herd—most of which are usually bedded down. This confuses the animals, who usually charge in all directions. Unable to locate the rest of the herd, each animal goes entirely berserk for a few moments, charging first one way and then another. During this time the hunter can usually kill one or more. Trying to sneak up on the herd in thick timber is not usually as successful. The animals detect the hunter first and simply charge off in a group, leaving the hunter nothing but an occasional flash of an animal—nothing that he can react to fast enough to kill.

Whether the prehistoric hunter resorted to these elk hunting techniques is not known. They have been described here only to provide an insight into elk behavior and to demonstrate the advantage that can be taken of the elk's distinctive odor. The last technique described will not work with deer or mountain sheep because they have no such smell and react differently than elk to the same stimulus. Antelope do not frequent thick timber, so this technique is automatically excluded. Neither would it work for moose. The hunter would not be wise to charge into a thicket where a moose was lying since that animal's reaction would more than likely be to charge the hunter. Anyway, the moose could be taken by other techniques. Moose, however, are beyond the scope of this book since they are a recent addition to the fauna of the area and are not known in the archeological record.

Large piles of elk antler were historical and very likely prehistoric features on the Northwestern Plains. A cave site (Elk Bone Cave, 24BH416) was excavated by Nelson (1942) and elk remains (but no pile of elk antlers) are mentioned. However, Crow Indians claim a pile of antlers estimated to be about 18 or 20 feet high (Conner n.d.) in this same cave in the later decades of the nineteenth century. A mound of elk antlers on the Missouri River above the mouth of the Yellowstone has been described by Denig (1930) as "covering an acre of ground and in height about 30 feet [p. 398]." (See also Conner n.d.)

OTHER ANIMALS

The large grazing and browsing animals by no means make up the full complement of animals taken by the prehistoric hunter. Remains of carnivores and scavengers appear in archeological sites, and probably the most successful way to obtain them was to use some sort of bait to attract them. In some areas today where bear hunting is a regular practice an old, decrepit horse is usually referred to as "bear bait" because that is a common fate for such an animal. The old horse is taken to a favorable spot and killed and the hunter waits for a bear to visit the carcass. The hunter then hides, watches, and waits for a chance to take a shot. The regular occurrence of bear, wolf, coyote, badger, bobcat, and skunk remains in buffalo kill sites suggests that the rotting remains of carcasses in animal kills may have served much the same purpose then as the dead horse does today. The same animals will be attracted to a pile of bones for years, long after they are bleached white and badly deteriorated. The "bear bait" horse is also used by trappers to attract carnivores and scavengers.

Each species of animal, both small and large, demands a unique method of procurement. Rabbits can certainly provide a significant amount of food, and although they are relatively easy to obtain procuring them is very different from procuring other small animals of comparative size, such as prairie dogs or marmots. And there are large differences in the methods for procuring the various species of rabbits (cottontail, jackrabbit, snowshoe) because their natural habitats and behavior patterns are different. Whether communal rabbit hunting prevailed in any part of the area is not known. However, the Green

River Basin was apparently occupied by Shoshonean groups, among whom rabbit trapping was common, in Late Prehistoric and protohistoric times. There is no reason to believe that Shoshonean rabbit drives on the same order as those in the Great Basin (see Steward 1938) were not carried out also.

In fact, one bit of evidence supports this. I visited a site that was being blown out of a sand dune in the Upper Green River Basin in the same general area and with likely cultural affiliations to the Eden-Farson site (Frison 1971 b) of postulated Shoshonean origin. The site yielded only a few projectile points, tools, and flakes surrounding a small fire hearth, but associated with it were a large number (47) of jackrabbit tibiae. Many others had been exposed and were decomposed. Several were in the process of being made into bone beads and demonstrated evenly spaced, encircling cuts. It seems unlikely that the number of animals represented here could have been acquired during a single hunting effort by a single person. Jackrabbits are usually hidden in daylight hours and the easiest way to procure large numbers is some kind of cooperative effort. The site is recent (at least Late Prehistoric) judging from the presence of small side- and base-notched projectiles. It was unfortunately destroyed during pipeline construction.

Using omnivores and carnivores as food may have had cultural restrictions in some cases. The evidence suggests, however, that animals such as bear, coyote, badger, wolf, and dog were eaten. Their bones in many cases were given the same treatment as the more commonly favored artiodactyls. Hunting these carnivores is an entirely different experience and requires techniques different from those for the other animals described in this book.

Rodent remains, especially porcupine and beaver, are common in Plains Indian sites. Prairie dogs, ground squirrels, and muskrats are less frequently found. Wood rats, and to a lesser extent mice, may have been significant as food; over 100 of both species along with many others (see Walker 1975) were recovered in a Paleo-Indian food refuse midden at the Medicine Lodge Creek site. Porcupines probably require the least in the way of hunting techniques of any animal. The rewards, at least in terms of protein if not flavor, may be the greatest of any hunting pursuit with regard to effort. The animal is clumsy, slow, and usually easy to locate. The only thing one needs to hunt a porcupine is a club or a rock and the good sense to stay far enough away from the animal's tail. The beaver is quite different, requiring quite a bit of skill to procure. Wood rats and muskrats are easily taken provided the proper techniques are known. The Great Basin Shoshonean was quite knowledgeable about wood rat trapping, but someone entirely unfamiliar with the ways of the wood rat would have to experiment for a long time before a full belly would be apt to result from his efforts at wood rat trapping. Many persons have lived for years in areas where wood rats are common and have not seen even one.

7

Studies of Animal Populations in Archeological Sites and Their Use in Biological and Cultural Interpretations

In any discussion of prehistoric hunting and food procurement activities in the Plains and immediately adjacent areas, the bison has top billing. Bison studies are complex because we are dealing with an animal whose evolutionary history, since the first evidence of its pursuit by humans in North America, is still imperfectly known. However, recent recovery and analysis of large and temporally controlled samples of bison are beginning to result in a better understanding of the evolutionary history of the species.

Earlier observers and collectors of fossil bison remains were hampered by a lack of temporal control and a compulsion to proliferate in their naming of species. One of the most variable characteristics of bison, the horn core, was used as the basis for designating species. At the same time these observers were unaware of the ranges of variation in single bison populations due to age differences and sexual dimorphism (Figures 7.1, 7.2, and 7.3). Some early Holocene bison were given separate taxonomic status although they were actually females of a known taxon. It was proposed that modern bison had an earlier existence because females of the earlier and larger forms were mistaken for males of the modern form. Liberties were sometimes taken during curation of certain specimens in order to attempt to correct conditions that had distorted the skulls during interment. The results were hopeless in terms of taxonomy (see, for example, Wilson 1975).

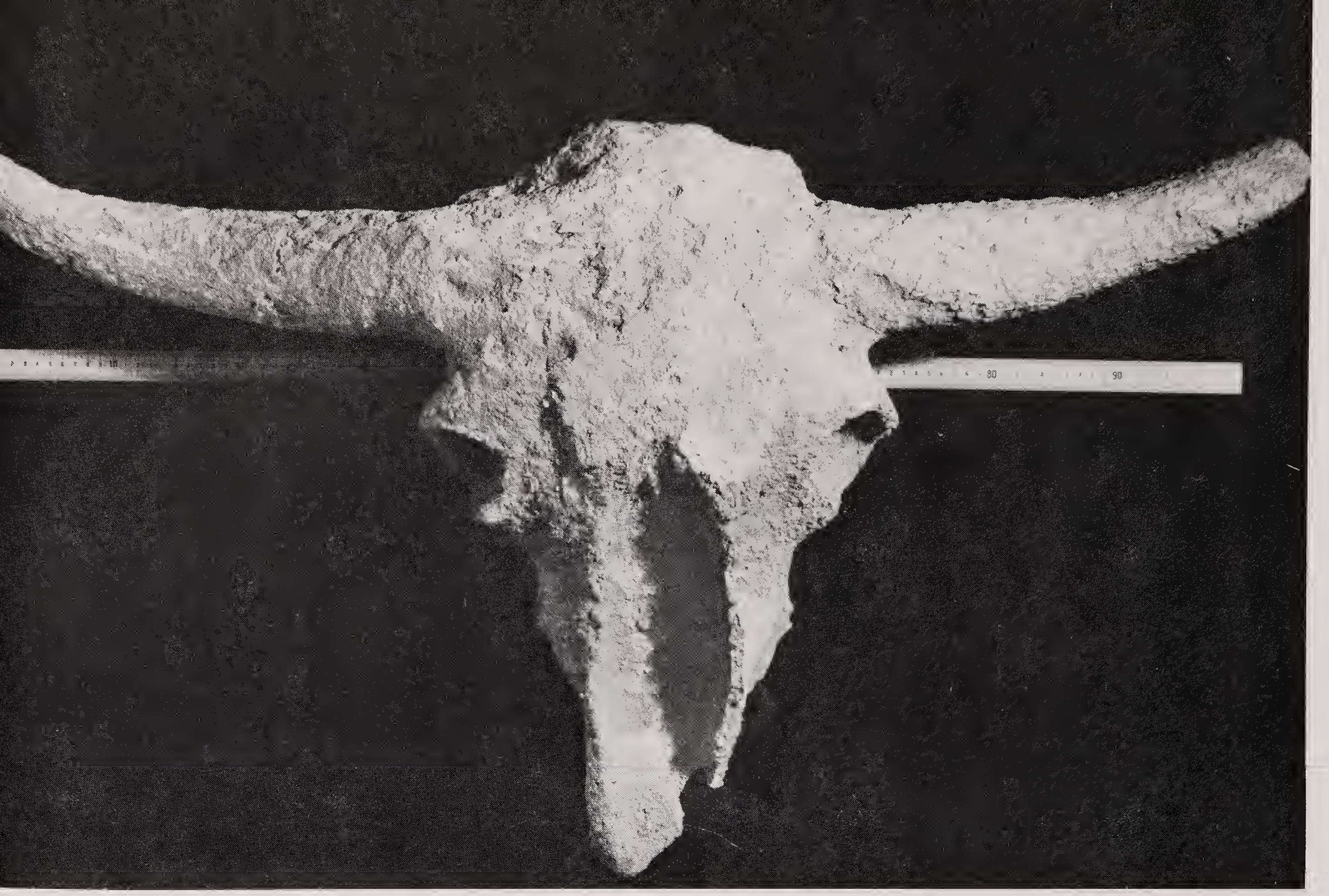
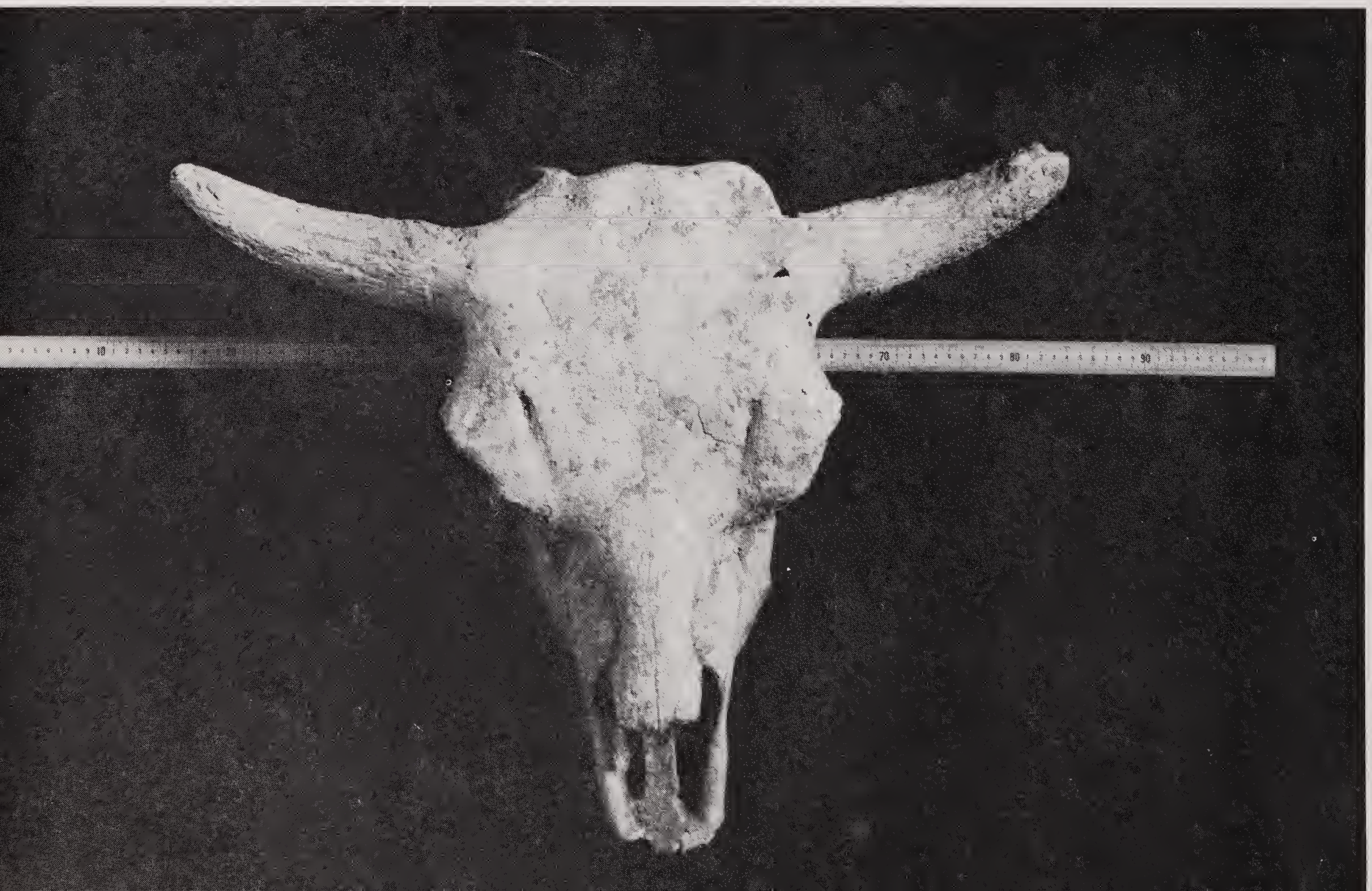


FIGURE 7.1. Bison skulls from the 10,000-year-old Casper site.



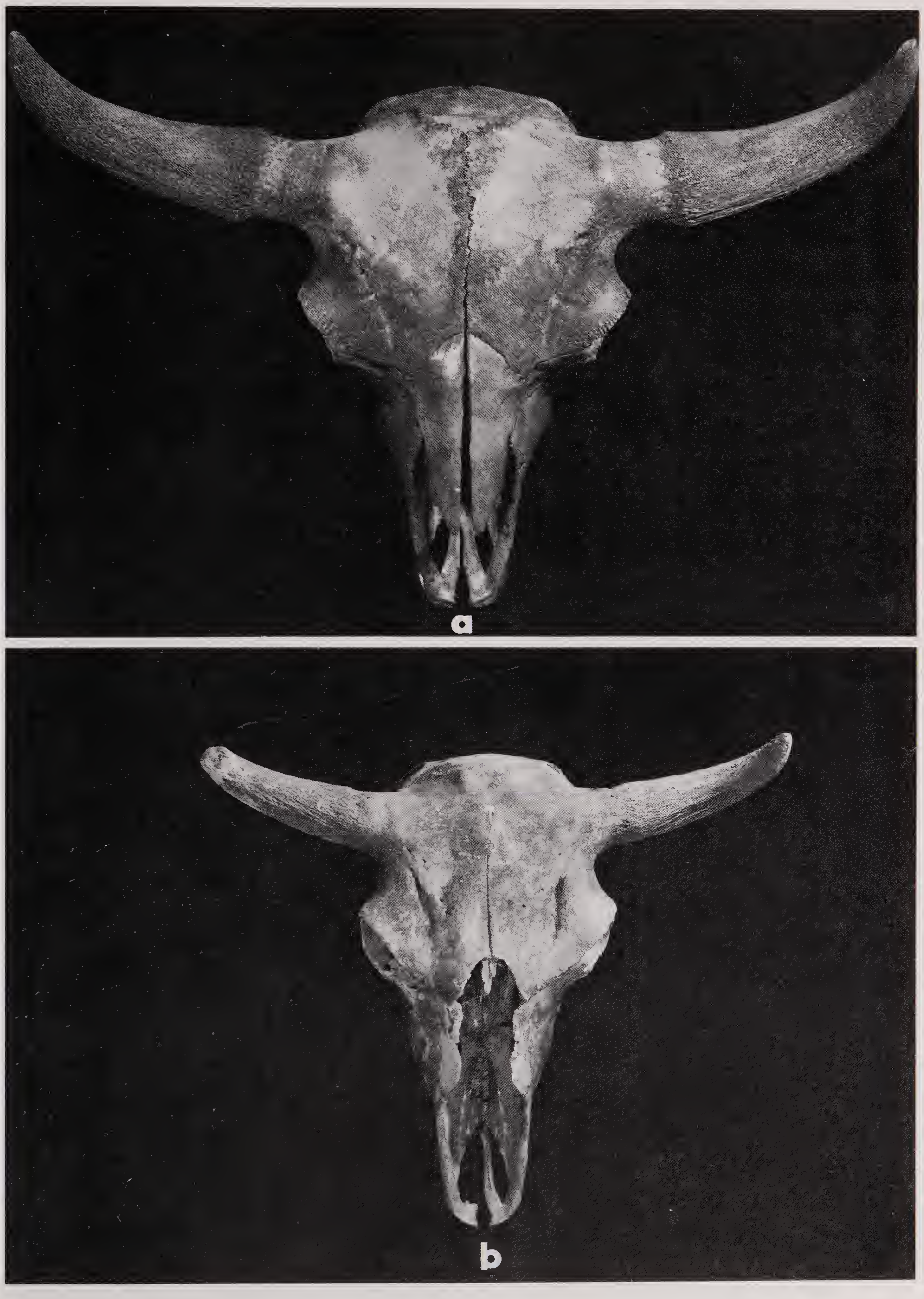


FIGURE 7.2. Bison skulls dated at about 10,000 years ago from central Wyoming. Maximum spread of (a) is 83 cm.

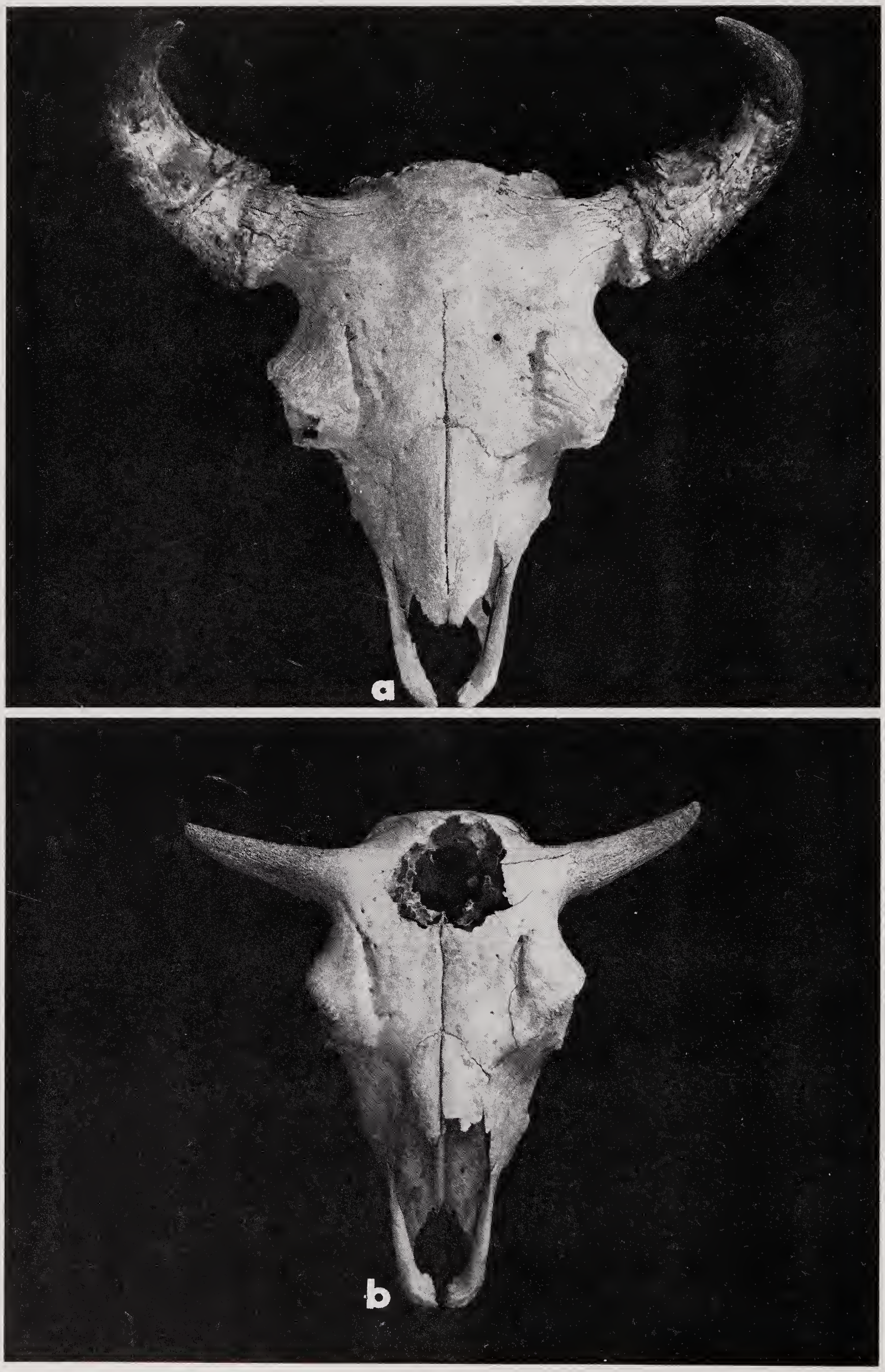


FIGURE 7.3. Modern bison skulls. Maximum spread of (a) is 63.5 cm.

Skinner and Kaisen (1947) attempted a taxonomic revision of bison and had some positive results, but they also were hampered in their efforts by a lack of both adequate samples and satisfactory temporal control. They did establish a standardized set of skull measurements, although some of the measuring criteria are imprecise and replication is difficult.

Apparently Skinner and Kaisen felt that there were two sympatric species of bison, *Bison antiquus* and *Bison occidentalis,* but no intermediate forms on the Central and Southern Plains. However, they did describe what could have been considered as an intermediate form, a variant (*B. antiquus figginsi,* or *B. taylori* of other investigators) *B. antiquus* with posteriad-deflected horn cores. In the Casper site bison kill (Frison 1974b; Wilson 1974a), dated at 10,000 B.P., both *B. antiquus* and *B. antiquus figginsi* of Skinner and Kaisen occurred in the same bison population, killed at the same time. This strongly supports the concept of intergradation of *B. antiquus* and *B. occidentalis* and it is now proposed that, although the two were contemporaneous, they were allopatric; as the result of a clinal depression to the south through time, *B. occidentalis* did follow *B. antiquus* over much of the Plains (see Wilson 1975:129–213).

It follows then that *B. antiquus* and *B. occidentalis* are variants but are significant only at a subspecific level. Both contributed to the ancestry of the modern bison. Wilson has therefore proposed that we accept taxonomic status of *B. bison occidentalis* for the northern variant and *B. bison antiquus* for the southern variant. Both chronosubspecies contributed to the modern Plains bison (*B. bison bison*) but wood bison (*B. bison athabascae*) evolved out of the more pure northerly form (*B. bison occidentalis*) (Wilson 1974a:141–142). We may be dealing with other subspecific forms that are imperfectly known at this time. For example, there are what appear to be exceptionally large bison up to the historic period in the Bighorn Mountains of Wyoming (see Wilson 1975:214–228). Only time and the recovery of more large, reliably dated samples can help to resolve these problems.

There are observable differences between the two chronosubspecies, *B. bison occidentalis* and *B. bison antiquus*. The former or northern one is characterized by a more posteriad deflection of horn cores, greater orbital protrusion, and less cranial breadth than the latter or southern one (Wilson 1975:138). We cannot as yet establish a precise dividing line between the two or the actual nature of southward clinal shifts at given points in time. We do know, however, that phenotypes of both did occur together at the Casper site at 10,000 B.P. and that the northern phenotype was present in the Wyoming Black Hills at 6400 B.P., as is clearly demonstrated at the Hawken site (Frison *et al.* 1976).

Dwarfing of bison has been a gradual process during the entire Holocene. There is some indication of a slight acceleration of this trend through the Altithermal or Atlantic Climatic episode. Along with dwarfing there was some dental microevolution involving molarization of premolars. It is now possible to determine the age of animals so closely that dentitions of animals of the same age in one group can be compared to animals of the same age in another group. This is important since bison molars demonstrate morphological variations at different stages of attrition resulting from wear. Preliminary observations of two Holocene bison populations indicate less molarization of P_4 in the

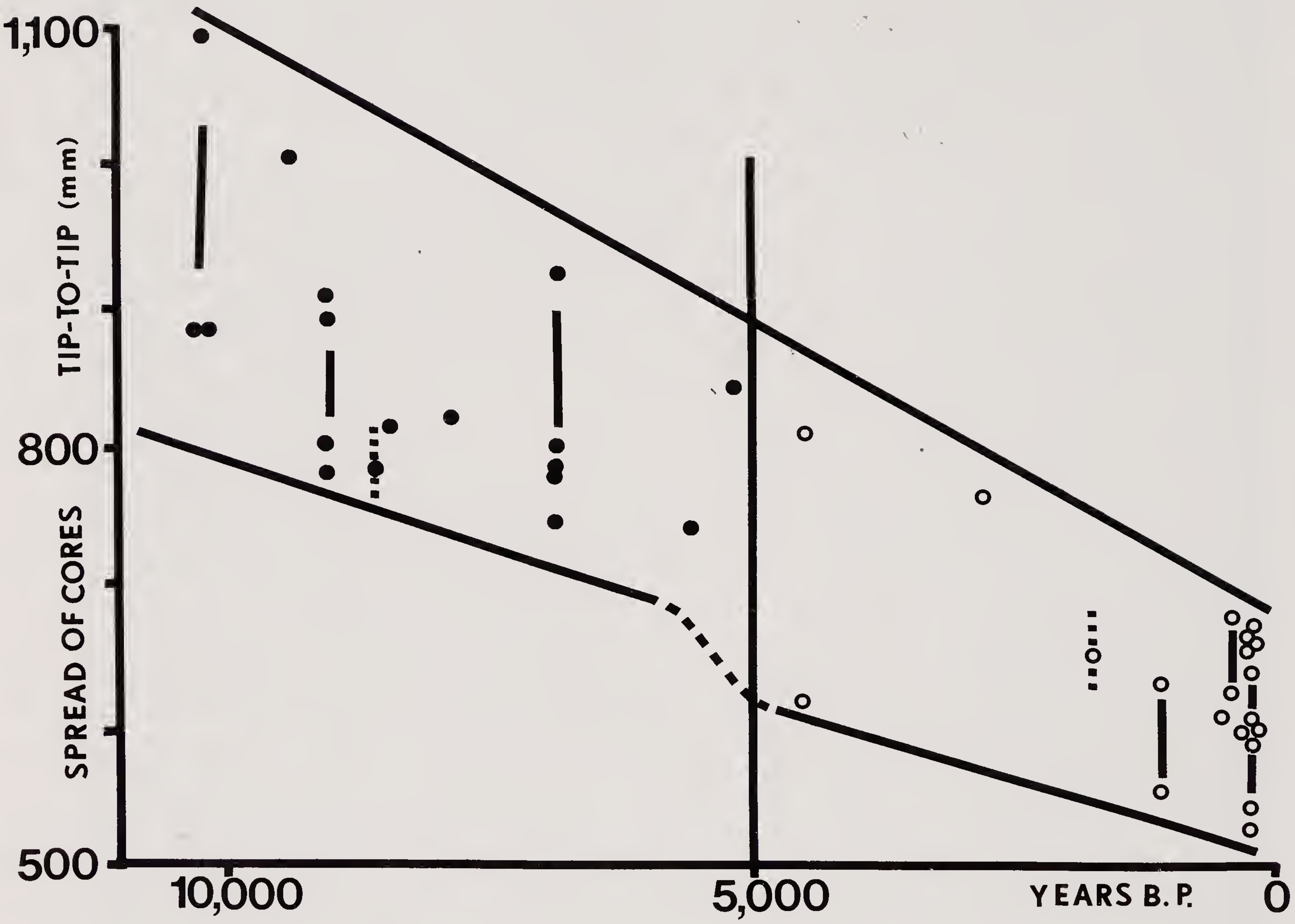


FIGURE 7.4. Horn core spread in relation to years before present (Wilson n.d.).

500-year-old Big Goose Creek sample than in the 10,000-year-old Casper sample. This is unexpected if molarization is a progressive trait, and the information provides a number of avenues for further research. On the other hand, observations on deciduous bison dentitions demonstrate more molarization on dP_4 on modern subspecies than for the Casper site *antiquus* (see Wilson n.d.:27–31).

The tip-to-tip spread of bison horn cores has decreased during the Holocene (the last 10,000 years) at a rate of about 32 mm/1000 years, with at least one fluctuation during the Altithermal (Wilson n.d.:12), which supports the idea of a continual dwarfing trend (Figure 7.4). A study of metacarpals and metatarsals from a number of Holocene bison kill sites (Bedord 1974) indicates a continual decrease in size; measurements of volumes of astragali (Zeimens and Zeimens 1974) give similar results (Table 7.1). We can now add the

TABLE 7.1
Volumes of Astragali

		Agate Basin			Olsen–			Buffalo		
Value	Folsom	Kill	Butcher	Casper	Chubbuck	Finley	Hawken	Creek	Vore	Glenrock
50										2
55									1	6
60								2	3	10
65							1	1	3	24
70							1	7	9	31
75				1			4	10	8	19
80			2	1	1	1	3	26	9	10
85				2	2	2	1	13	6	2
90	1		2	2	4	1	5	10	4	7
95	3	3		5	8	2	1	8	4	3
100		3		10	5	3	1	12	3	4
105		5		9	6	5	4	4	1	1
110	4	1	1	9	9	2	3	2	3	3
115	3	1	3	5	2	5	6			
120	5		1	5	5	3	2	2		
125		2	3	3	2	2	3			
130	1		1	1		2		1		
135		3				4				
140		1		1		5				
145	2	1		2	1					
150	1				1					
155	4	1		1						
160	1	2								
165										
170	1									
175	1									
180										
185										
190										

measurements on both these postcranial skeletal elements from a large sample of the original Folsom site bison; these are observably larger than those from the Casper site and other sites of about the same period. A sample of metatarsals and metacarpals was also recovered recently from the Agate Basin site. These are close to those of the Folsom site and further support the dwarfing hypothesis (Tables 7.2 and 7.3). The range of variation in size also points out the need for large samples of a bison population before meaningful assessments can be made. We do not at this time have an adequate comparative sample of postcranial elements of bison from dated Clovis period sites, but measurements on selected specimens from Murray Springs (see Haynes 1970) and a single specimen from the Union Pacific Mammoth site (McGrew 1961) suggest that the bison during Clovis times were still larger than those of Folsom times.

TABLE 7.2
Bison Metatarsal Lengths for Mature Animals

		Agate Basin			Olsen–		James			Buffalo		
Value	Folsom	Kill	Butcher	Casper	Chubbuck	Finley	Allen	Hawken	Scoggin	Creek	Ruby	Vore
230												
231										1		
232												
233										2		1
234												
235												2
236												
237								2				2
238												1
239										1		2
240										2		7
241									1	1	2	5
242										2	2	3
243												7
244								2		2		3
245			1							3	1	6
246									2	3	1	5
247					1					3		7
248					2			1		6	1	3
249	2	1						2		3	1	4
250	1			2					2	2	2	6
251	1			1				2		5	1	4
252				3			1	1		3	1	8
253	1	1		3		1		1		1	2	3
254		2	1		1			1		3		3
255		1		1					1	4		4
256				2				3		5	5	7

257	1			1	1							1
258				1		1				3		1
259	1	1		2	1	2		2		2		4
260	2	1		1				2		1		2
261		2	2	3	2	1						6
262			1	4		2	1			1	1	1
263	2				1	3		2		2	1	3
264			1	3		2	1			1	1	1
265		3		3	4	2	1	1		2	1	
266		1		3	1			1		1		3
267	2		1	2		6	1		1			
268	2					2	2	2				
269		1		1	2	3		1			1	1
270	1	2			2	2						1
271	1				1		1	1		1		
272		1	1	1		2						
273	1											
274		1		3	1	1						
275		2		1	2							
276				1	2	3						
277	2					2					1	
278		1				2	1					
279	1							1				
280					1							
281	1				2							
282		1										
283												
284								1				
285												
286	1											
287												
288												
289												
290	1											

TABLE 7.3
Bison Metacarpal Lengths for Mature Animals

		Agate Basin			Olsen–		James			Buffalo		
Value	Folsom	Kill	Butcher	Casper	Chubbuck	Finley	Allen	Hawken	Scoggin	Creek	Ruby	Vore
177												
178												
179												
180												
181												1
182												
183												
184												
185										1		1
186												3
187										2		
188											1	1
189										1		3
190									2		2	2
191									1			1
192												4
193										1		4
194										2	2	5
195										2		9
196		1							1	5		6
197	1								2	4	1	6
198										2	2	6
199		1								5	2	10
200				3				1	1	2		9
201					1	2		4		5	4	8
202			1	2		1		2		4	1	14

203				1					3	3	2	13
204		1		4	1	1		2	3	5	3	6
205					1	2	1	1		6	3	13
206				3	1	2		3		7	6	8
207			1		1	2		1		4		3
208		1			1	3	2			2	1	8
209	1			1	1	2	1			4	1	5
210	4	1		1	1	2		1		3		5
211	3	1	1	2		2	1	1		3		3
212			2	1	2	1	1			5		5
213	1	2		6	3	3		1		3		2
214	2	2		4	3	3		3		2	1	1
215				6	1	6		1		2		1
216		2		4	2	6		1		3	1	
217	1			5	4	2			2			3
218		2	1	3	2	4	1	2				2
219		1	2	3	1	2	2	2				
220		3		2	1	3		1				
221				2		1	1					
222				2	4	4		1				
223	1	1				3						
224		1		3	1	4						
225		1		2	1							
226	2											
227		2				1						
228					1	3						
229		2			1		1					
230						1						
231												
232	1	1					1					
233							1					
234												
235			1									
236	1											

With regard to actual bison procurement by humans, we may be on somewhat dangerous ground in assuming that the extinct variants of bison demonstrate identical or similar behavioral patterns to the modern form. Present-day bison congregate in large herds but the extinct variants may not have done so. They may have been more solitary, less excitable, and easier to approach. On the other hand, the fact that large numbers were stampeded into deep, steep-walled arroyos (Wheat 1972), driven into parabolic sand dunes (Frison 1974b), and driven into arroyo traps (Frison *et al.* 1976) provides some basis for comparison. The modern bison can be put through all the paces that we know the extinct ones were put through, so they probably were not too dissimilar.

The larger size of the extinct bison by itself may have been a determining factor in the selection of procurement methods. A modern bison, especially a mature bull, is quite formidable, especially when contained within a corral or other holding structure. Adding an average of several hundred more pounds per animal and another foot to each horn and projecting the horn more directly outward could hardly help but give any hunter cause for serious thought and judicious consideration before rushing into a direct confrontation with the animal, unless he had considerable experience and was equipped with well-proven weaponry.

Bison kills by prehistoric human groups have in many cases provided us with large samples of bone even though many skeletal parts are missing because of past methods of butchering and processing. Paleontologists have utilized a methodology to analyze fossil bone beds with considerable success. This is subsumed under the term *taphonomy* and its usage is described as follows:

> Taphonomy is concerned with the factors intervening between a living fauna and the fossilization of a fraction of it. It deals mainly with the post-mortem history of animal remains (especially their decay, transportation and burial) but also with the cause of death. Taphonomy overlaps paleoecology only insofar as the mode of life of an organism influences its choices of burial and preservation [Voorhies 1969:2].

Voorhies (1969:2) distinguishes carefully between paleoecology and taphonomy but points out that information derived from the latter can be of importance for the reconstruction of the former. The use of archeology in taphonomy studies introduces the cultural factor into the means of burial and preservation of animal populations.

Voorhies' initial study dealt with an early Pliocene vertebrate fauna. However, the principles involved and methodology used provide a usable and quantifiable means of analyzing faunal remains from archeological sites. The results can then be used to determine certain factors about the animal populations, and these facts in turn provide information on what the humans who were exploiting the animals were doing. In this sense and toward these ends, a number of investigators including myself have utilized certain of the concepts of taphonomy and analyses of population structures with positive results. In

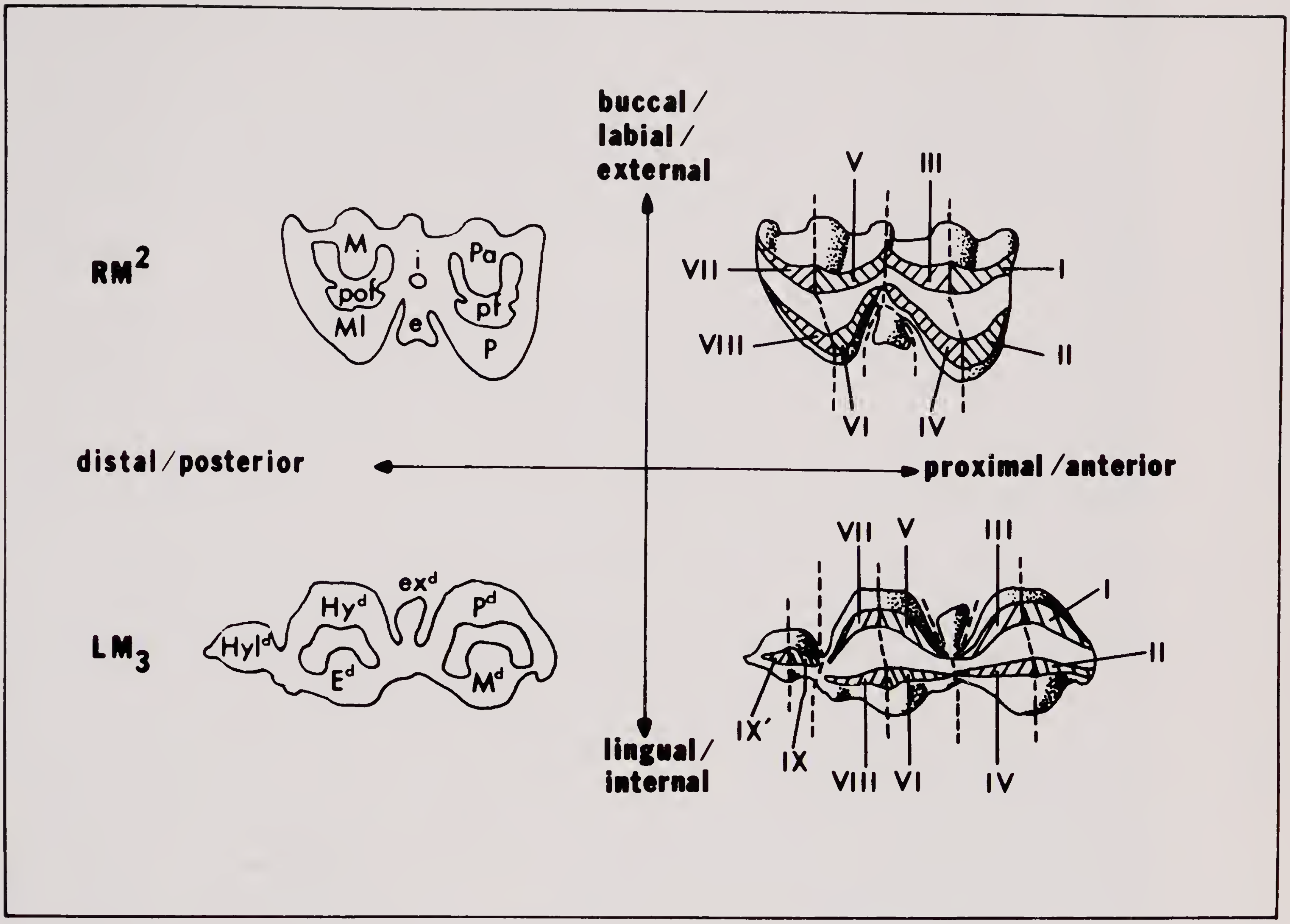


FIGURE 7.5. Descriptive aids for the discussion of bison dental morphology and wear. Upper left: right M^2 (worn), showing cusps and fossettes. e, endostyle; i, interfossette; M, metacone; Ml, metaconule; P, protocone; Pa, paracone; pf, prefossette; pof, postfossette. Upper right: right M^2 (lightly worn) showing numbering of wear facets referred to in text. Numbers increase in posteriad direction. Lower left: left M_3 (worn), showing cusps. E^d, entoconid; ex^d, exostylid; Hy^d, hypoconid; Hyl^d, hypoconulid; M^d, metaconid; P^d, protoconid. Fossettes as in RM^2. Lower right: left M_3 (lightly worn) showing numbering of wear facets referred to in text. Numbers increase in posteriad direction. Directional terminology for teeth is shown at termini of the four cardinal axes: alternatives reflect the varying usage of different authors. Other terms are also available, and are used in specialized contexts. (Frison et *al.* 1976).

their analysis of such animal populations, archeologists must allow for one variable that need not be considered in paleontological studies. This factor is the human element, which added different dimensions in terms of its effects on the animals and their remains after death. For a more detailed and comprehensive treatment of the subject of population dynamics the reader should also consult Deevey (1947) and Kurten (1953, 1964).

In order for either the archeologist or the paleontologist to derive meaningful interpretations from a sample of a population, accurate means of determining the age of each specimen represented in the sample are necessary. To date, tooth eruption and wear seem to offer the most reliable results at least on the larger ungulates. Age determination accurate to a month or less is possible on young animals, especially those less than a year of age. Reasonably good results can be obtained on immature animals 1 year of age to maturity, at about 5 years. Beyond this, age must be estimated according to tooth wear. As long as the sample being studied is from a single population that died at a single point in time, yearly increments of wear can be detected and age groups 1 year apart can usually be detected.

The principles involved in determining age are simple and straightforward. Tooth eruption schedules are systematic and predictable. As long as teeth are erupting, there is an interaction between eruption and wear that is age-diagnostic. Earlier schemes for describing mammalian teeth (see, for example, Crompton and Hiiemae 1969) were designed to give the evolutionary history of dental morphology, not to provide for accurate descriptions of tooth wear. We have therefore proposed (Frison *et al.* 1976) a descriptive model for bison tooth wear (Figure 7.5). Using this descriptive device, a standardized method of determining bison tooth wear is possible, so different investigators can compare results. The model can probably be applied to all artiodactyls and similar wear diagrams can be constructed for the dentitions of other species. The first attempts at determining bison age were made using lower teeth, since these were better preserved and more frequently recovered in archeological sites. However, the upper teeth have proven as reliable as lower teeth (Wilson 1974a). Samples from the Hawken site were aged by two investigators independently, one using upper teeth and the other using lower teeth; the results were identical (Frison *et al.* 1976).

The method requires a series of specimens of known ages for comparison. Fortunately there are a number of commercial bison herds and some wild herds such as those in Yellowstone Park; these have provided the necessary samples from animals of known age (see Frison and Reher 1970). Fetal material, if present, is of importance since it demonstrates systematic changes in size and development over short periods of time and often appears in both camp and kill sites. In fact, fetal material may prove to be of great value as an indicator of seasonality as soon as better collections of known-age materials are available.

We know that rutting and birthing seasons are nearly constant from year to year for all the larger animals commonly hunted in North America. As a result, each year's crop of young will be spread over the birthing period. With bison, for example, most calves are born within a period of a month to 6 weeks. The calving begins slowly, builds up to a peak and ends like it began. In addition, an occasional calf is born out of normal calving period; such a calf usually has a poor chance of survival. The early calf faces cold spring weather, and the summer calf may not achieve sufficient growth to survive a severe winter. As a result, those born outside the normal calving period may not seriously affect the structure of a given bison population. Even a surviving female calf born outside the normal calving period is as likely as any other to breed and have its offspring during the normal breeding and calving periods. However, a calf born late in the summer may not attain enough size and maturity to bear offspring until a year later than ones of the same calf crop born during the regular calving

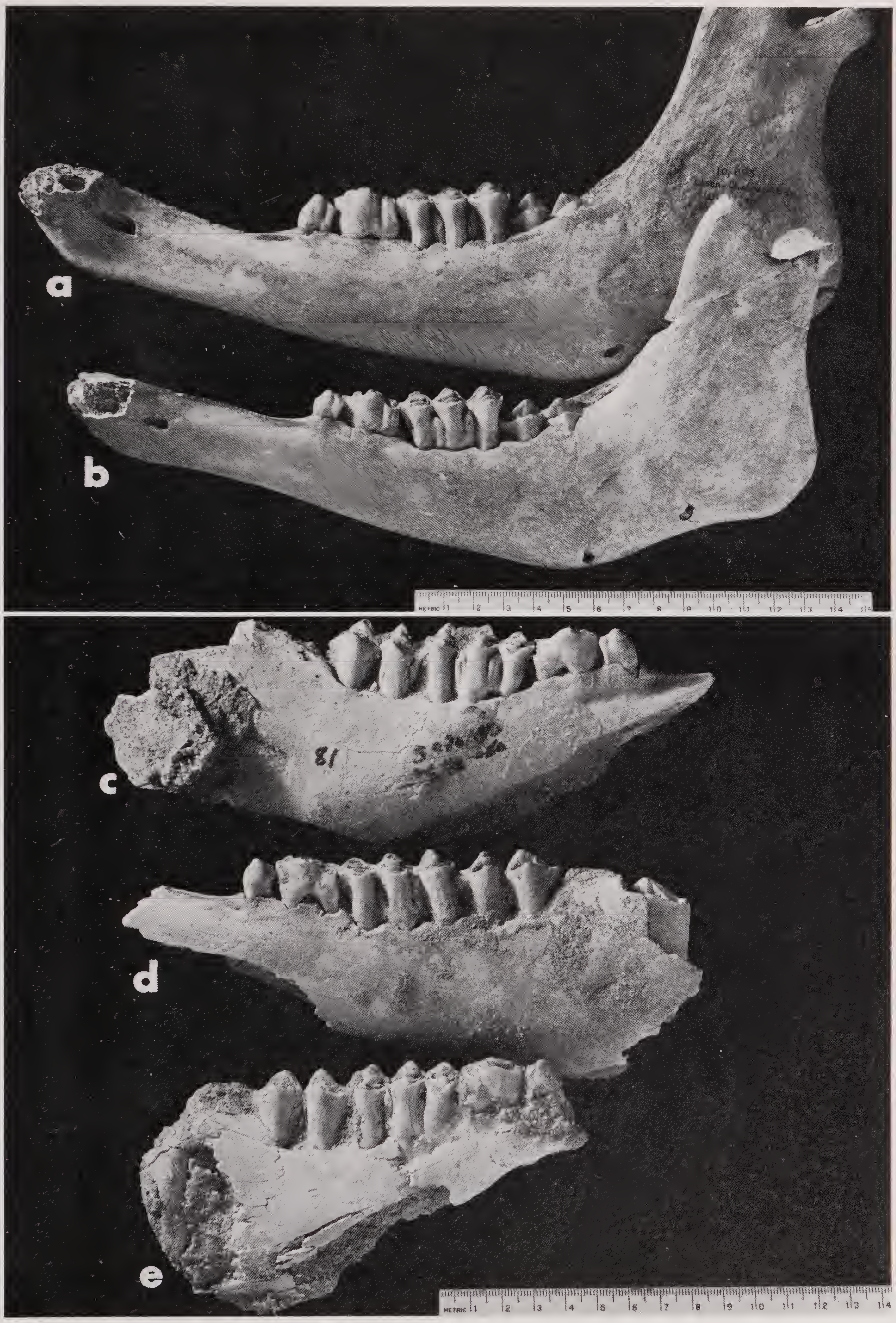


FIGURE 7.6. Bison calf mandibles from Olsen–Chubbuck (a, b) and Casper (c–e) sites.

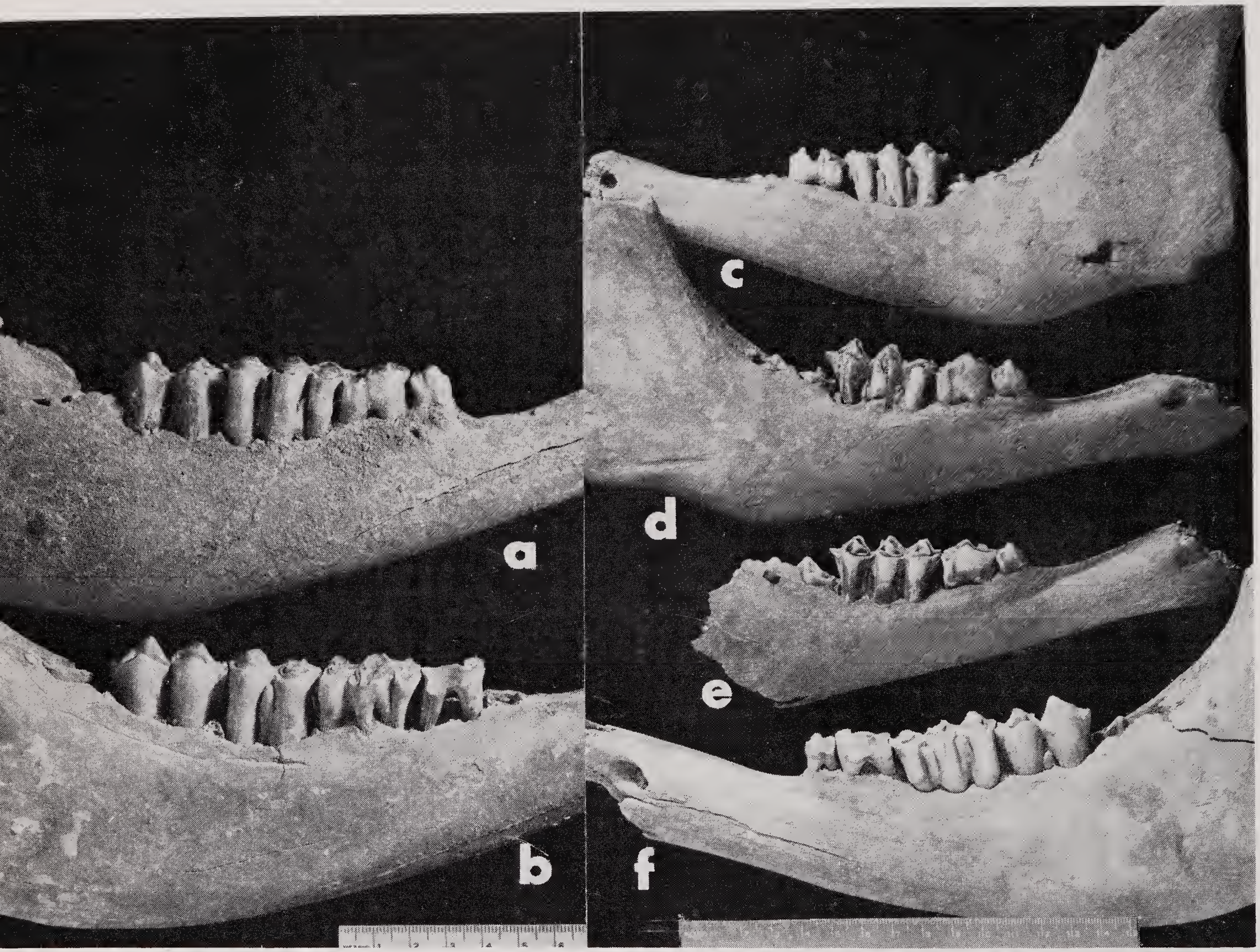


FIGURE 7.7. Yearling (b, f) and calf (a, c–e) mandibles of different age groups from the Vore site.

season. And sometimes the early calf that survives breeds a year early and dies because it is not developed enough to give birth to its calf.

Using tooth eruption and wear criteria to determine the ages of young animals requires mostly specimens of known age and a good deal of practice. Calves from the Olsen–Chubbuck site that were probably killed in late summer or early fall (Figure 7.6a, b) demonstrate M_1's in a much earlier stage of eruption than those from the Casper site (Figure 7.6c–e) that were killed in late fall or early winter. Note also that although there is a noticeable size difference in the two Olsen–Chubbuck specimens (one is probably male and the other female), eruption stages are in close agreement.

The Vore site (Reher and Frison n.d.) was a bison jump of the Late Prehistoric period with a number of components. Not all the jumping operations occurred at the same time of the year. Calves (Figure 7.7a) and yearlings (Figure 7.7b) in one level demonstrate tooth eruption indicative of a late fall operation whereas calves (Figure 7.7c–e) and yearlings (Figure 7.7f) from another level were killed in late spring or early summer. Calves (Figure 7.8a) and yearlings

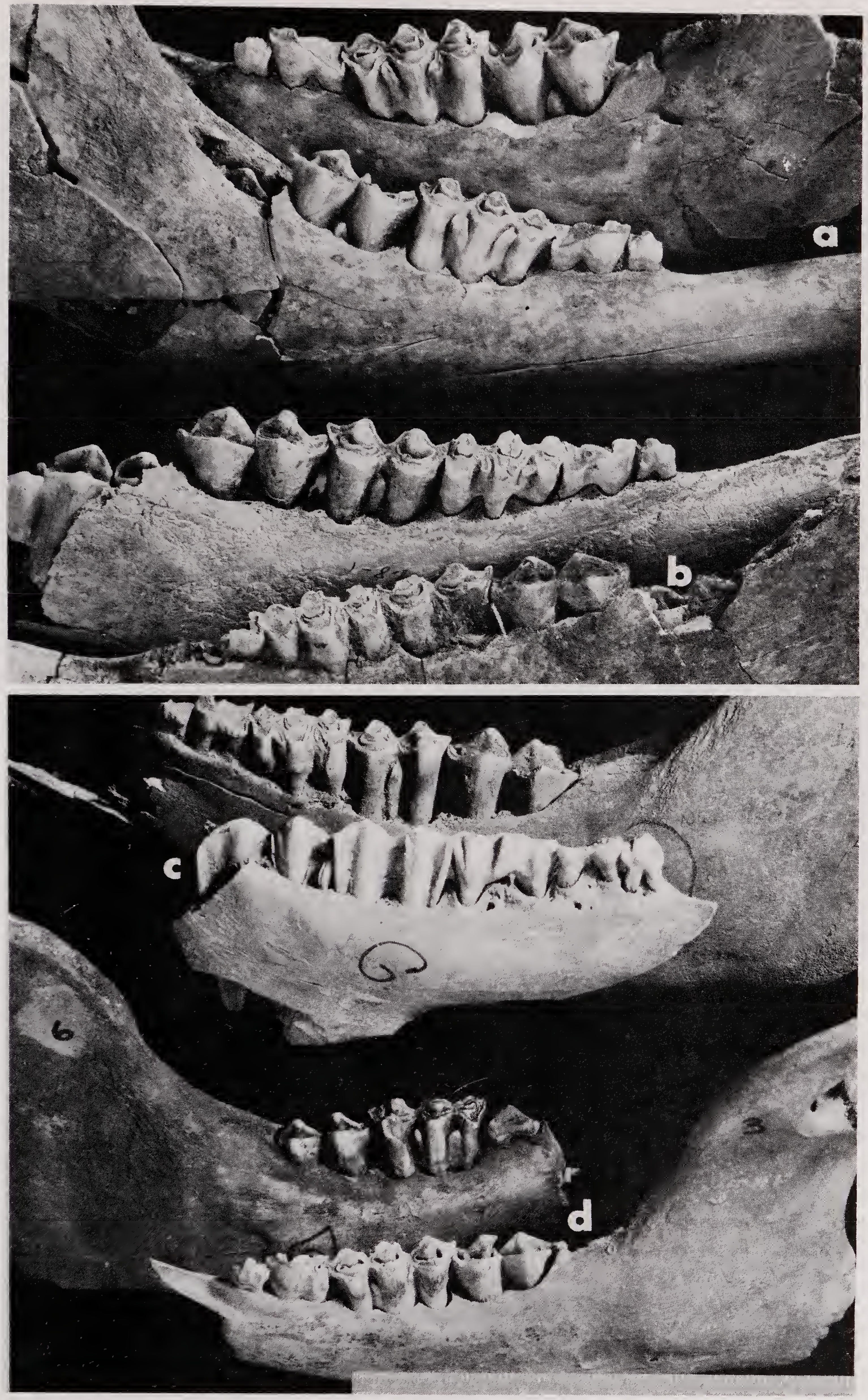


FIGURE 7.8. Calf (a) and yearling (b) mandibles from the Hawken site; yearling (c) and calf (d) mandibles from the Glenrock Buffalo Jump.

(Figure 7.8b) from the Hawken site were killed about midwinter according to mandibular tooth eruption and wear. Using the same criteria, we found that calves (Figure 7.8d) and yearlings (Figure 7.8c) from the Glenrock Buffalo Jump were killed in the fall.

The method is readily applicable to the remains of animals other than bison. The pronghorn (*Antilocapra americana*) has shorter breeding–birthing seasons than bison and close time-of-year determinations are possible (Nimmo 1971). Using these data, remains of over 200 antelope recovered in a protohistoric Shoshonean campsite were found to have been killed between late October and early December. This strongly suggests the animals were taken in some sort of a communal trap rather than through ordinary day-to-day hunting (Frison 1971b). Recent studies of a large sample of mule deer (*Odocoileus hemionus*) remains from a Middle Plains Archaic period campsite indicate that the deer were killed throughout the winter months rather than at a single large kill. In this particular site situation it would be tempting to regard it as a single kill or several closely spaced kills, were it not for the evidence from age determination (Simpson 1974).

A reevaluation of some bison kills has been possible using tooth eruption and wear as a time-of-year indicator. The Olsen–Chubbuck site (Wheat 1972) was apparently a late summer or early fall event since calves from the site are close to .4 year of age. The Finley site (Moss *et al.* 1951) was apparently a late fall or early winter operation. Insufficient ageable material for a closer determination was recovered in the youngest age categories. Agate Basin activities (Roberts 1943, 1951) took place much later in the year, close to the calving period (on the basis of calf teeth recently recovered from both butchering and kill areas of an Agate Basin level at the site). At both Finley and Agate Basin the operations were either short-term single events or a number of closely spaced events rather than several spread out over a long period of time.

Large samples of the animal population in a kill site usually reveal individuals of all age groups within the population. With such data, we can derive life tables and survivorship curves, which tell us something of the viability of the population. In the Late Prehistoric period there is evidence that there were as many as 16 or 17 age groups for bison (see Reher 1970, 1973:98–99) whereas at the Casper site we could only find about 12 (Reher 1974b:113–124). The same situation was confirmed for the *B. bison occidentalis* bison at the Hawken site (Frison *et al.* 1976). There is evidence also of stress on the Casper bison population as is demonstrated by tooth abnormalities. These include abnormal M_3's (Figure 7.9a, d–f; Figure 7.10a, b), congenital absence of a premolar tooth (Figure 7.9a, c; Figure 7.10a–c), malformed teeth other than M_3 (Figure 7.9a, c; Figure 7.10a, b), deflected tooth rows (Figure 7.9b), and others (see Wilson 1974a). From these we may eventually understand why the larger, extinct bison were not able to survive. The solution of problems such as these may tell us more about the human populations as well. For example, the stress may have resulted from intense human predation.

Two other concepts of importance in studies of taphonomy and population dynamics are catastrophic and attritional mortality. Attritional mortality is the normal dying-off of the population and can be detected by a look at the

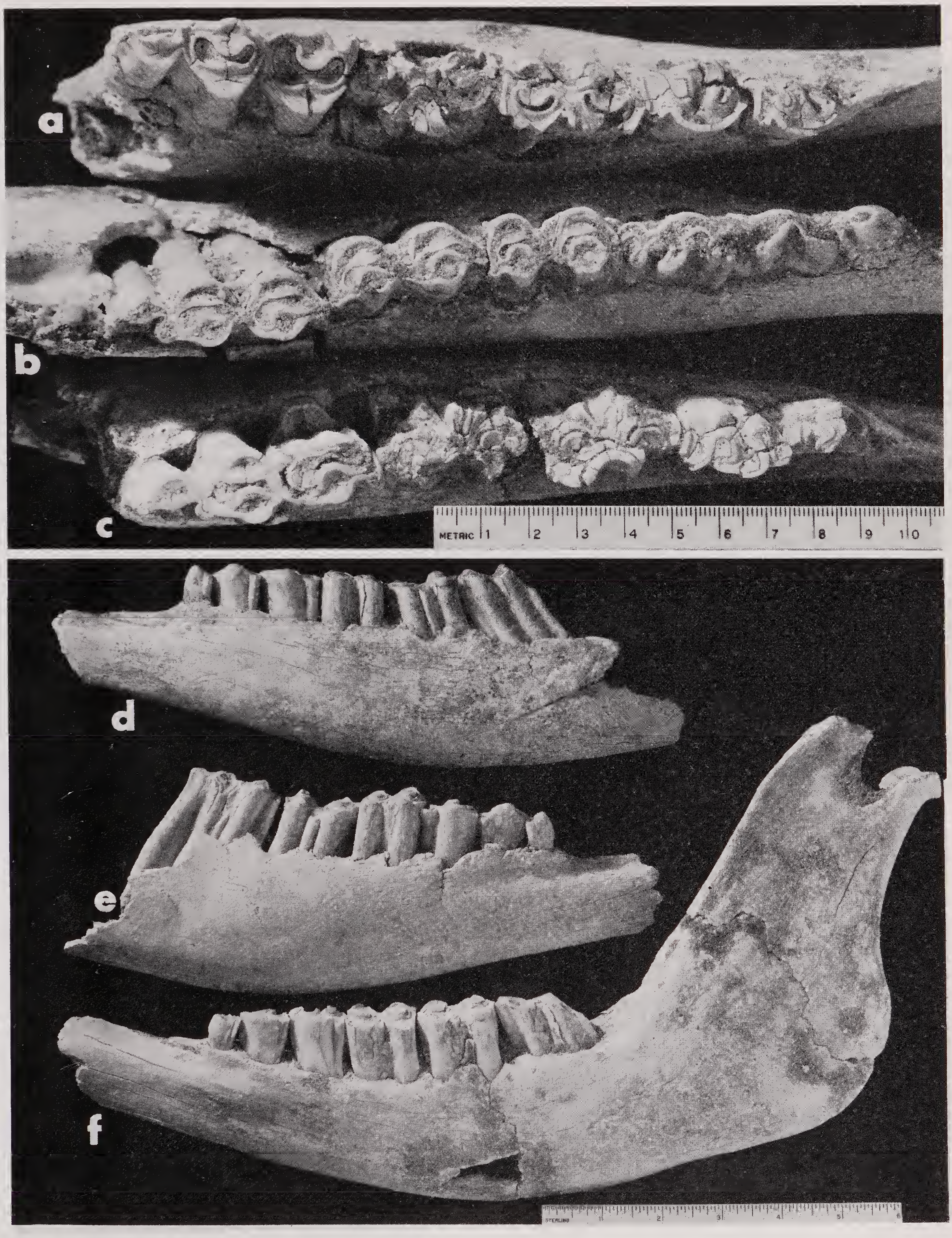


FIGURE 7.9. Pathological teeth from the Casper site.

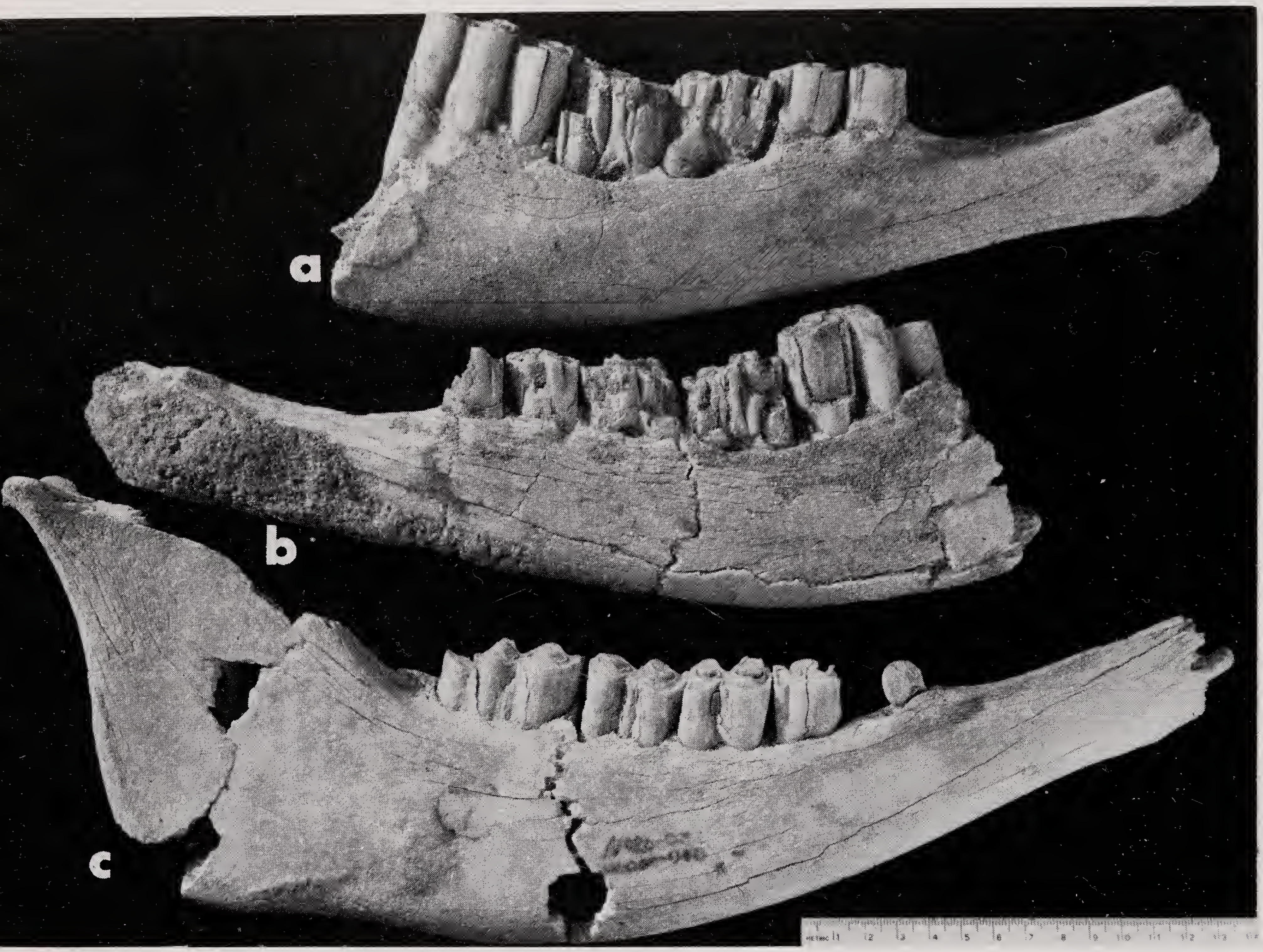
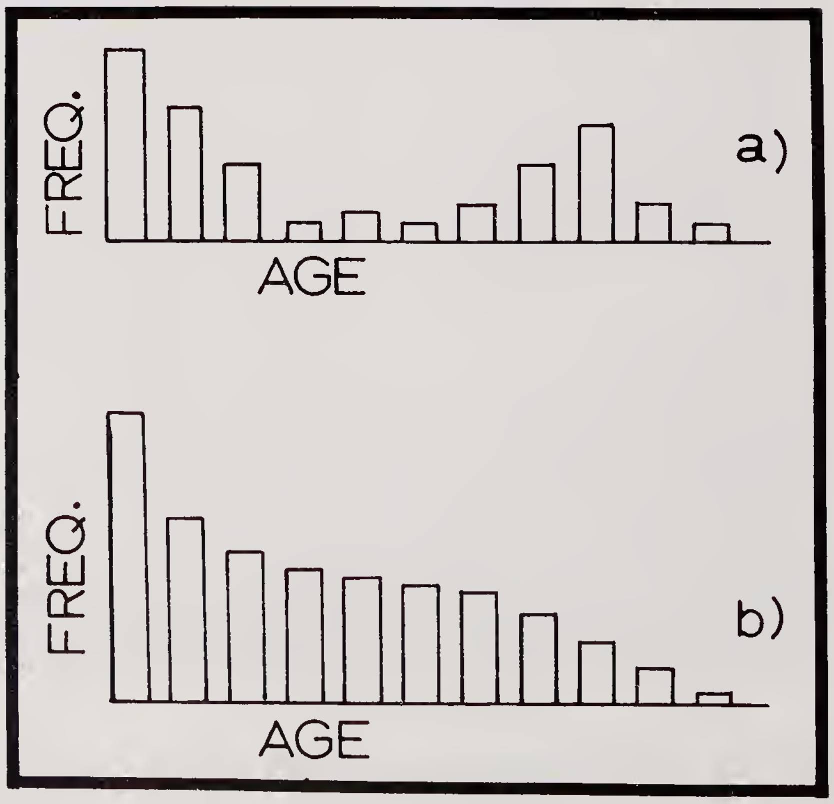


FIGURE 7.10. Pathological teeth from the Casper site.

FIGURE 7.11. Idealized representations of frequencies and ages of attritional mortality (a) and catastrophic mortality (b).



population structure (Deevey 1947:289). In a normal dying-off situation a large number of the very young die. The ones that pass a critical age are no longer subject to the earlier high probability of death and the remainder of the age groups gradually increase from a low value to a higher value and then decrease to zero as the maximum age of individuals in the population is reached. Results produce a population structure that contains mostly the very young and the middle-aged (Figure 7.11a).

Catastrophic mortality is different and represents a sample of the total population at a given point in time. Large animal kills by trap or stampede are examples. A number of smaller kills in the same spot within a short period of time produce nearly identical results. The ideal population structure as seen in a catastrophic kill is different from that of one represented by an attritional situation. It contains large numbers of young and grades into slightly smaller numbers of early mature animals and fewer old ones (Figure 7.11b).

The catastrophic kill and its analysis are of great interest to archeology. These are the situations whereby large population samples were taken, and, although human activities of butchering and processing resulted in considerable dismembering of the animals and removal of some parts, enough elements are usually left to form a base for analysis. Mandibles were one of the less desirable items on the bison carcass and were often discarded at the kill sites. Fortunately, not all mandibles were left at kill sites and some were taken to camp and butchering areas. The presence of mandibles from the same population sample in both kill and camp and/or processing areas provides a means of checking one area against the other. The utility of this was demonstrated recently at the Big Goose Creek site (Frison 1967a), a Late Prehistoric period bison jump and campsite complex near Sheridan, Wyoming. The initial interpretation was that this was a bison jump with a butchering–processing area associated. An ageing study of the bison remains in the jump and the presumed processing area proved this to be untrue. The bison were jumped in the middle of fall and the mandibles from the kill area left little doubt of the time of year and of the fact that a single event or several closely spaced events were involved. The upper teeth from the camping area revealed that the animals there had been killed over a period of several months during the winter. Although all indications suggest that both areas are manifestations of the same cultural group, we are still lacking the processing area for the jump. It was probably alongside the jump and was removed by stream action.

In the Big Goose Creek site winter camp area the seasonality of procurement of the bison was further supported by a study of fetal remains. Fetal bones appear at several growth stages and from our rather limited sample of fetal bison material of known age, we feel the site specimens represent fetuses taken from animals killed from about November to February (Frison *et al.* n.d.).

The Wardell Buffalo Trap (Frison 1973b) is another example of a bison kill that demonstrates the utility of determining the animals' ages in order to determine seasonality. The bison from the kill site (a corral or pound situation) were determined to be in age groups of about .4, 1.4, 2.4 and so forth years (Reher 1973). A large butchering and/or processing area is immediately adjacent to the corral and mandibles recovered from the processing area fall into the same time-of-year pattern as those from the kill. This provides strong evidence that the processing area is where the animals from the kill were taken. The site was a multicomponent one, indicating the fall kill was repeated several times.

Studies of population dynamics can be extended to include animal populations other than the large herbivores (bison, deer, and antelope) already mentioned. Recent archeological investigations in a deep, stratified site in the Bighorn Basin of Wyoming revealed intensive use of rodents by Paleo-Indian hunting and gathering groups. Included in a cultural level dated at about 9500 B.P. was a bone midden containing a minimum number of 101 pocket gophers (*Thomomys talpoides*); 135 bushy-tailed wood rats (*Neotoma cinerea*); 134 montane voles (*Microtus montanus*); and 180 prairie voles (*Microtus ochrogaster*). Many other species were represented but in much smaller numbers. Only part of the midden was excavated.

All four species were present in quantities large enough for a population study to be done. Apparently the *Neotoma cinera* (bushy-tailed wood rat) is characterized by a predictable yearly breeding season. A study of the wood rat dentitions from the site indicated three groups: those approximately 2 years of age, those approximately 1 year of age, and the newborn of the year (Walker 1975). It is believed, based on tooth eruption and wear, that the wood rats were killed in late July or August, which provides a basis for suggesting a late summer occupation of the site.

More reliable means of determining the age of animals from archeological sites may appear in the future. Other indicators have been tried, such as bone ossification schedules, cementum annuli accumulation on roots of teeth, and chemical contents of bone. So far not enough is known about bone ossification rates to determine age as closely as with tooth eruption. Annual or seasonal rings on bison molar teeth have not been visible enough for meaningful age determinations. Some of this might be due to chemical content of certain soils. Incisor teeth have not been tried because few are preserved in most archeological sites. General distinctions between young, juvenile, and mature animals may be made by the analysis of the chemical content of bone, but this is not yet precise enough for seasonality to be determined.

The archeologist requires sex determinations in animal populations other than as an aid in determining the evolutionary history of the species, so his interests are somewhat different than those of the biologist or paleontologist. The population structure reveals the age and sex of the animals recovered in kill sites and the time of year the kill occurred. With this kind of information and a knowledge of animal behavior, it is then possible to assess the procurement methods used because nursery herds behave differently than groups of mature males. The nature of the procurement methods also indicate something of the size of the human group involved. Knowing the time of year of an animal kill operation allows the investigator to formulate hypotheses concerning the seasonality of other economic activities.

Another area of interest to the archeologist is butchering and processing of animal products. Butchering mature male bison is different than butchering a smaller female or a still smaller calf. Consequently different procedures were used on each. The amount of food products obtained differs also with the ranges of size and differences in sex. The amount and kind of food products obtained in a communal animal kill are important in the final analysis of site data. Reliable sex indicators other than skulls are therefore important.

Metacarpals and metatarsals are bones that occur commonly in kill sites. They were sometimes used as tools and were occasionally broken for bone marrow, but as with the mandibles, they were not among the more desirable bones and were usually discarded. In addition they are large bones with thick outer walls and usually preserve better than other bones. The same can be said for the astragali, which are among the most solid and compact of all the skeletal elements. So, metatarsals, metacarpals, and astragali are usually present in numbers sufficient for analysis. These bones are important in supporting the animal's weight, and their relative size should reflect the size of the animal. Some positive results in determining bison sex have resulted from careful study of these bones (Bedord 1974). Volumes of astragali can easily be determined and the idea is not new. Sellards (1955:138) and Lorrain (1968) used astragali volume measurements to demonstrate different size ranges between modern and extinct forms of bison in the Southern Plains. Similar studies on sites further north support the use of astragali as size indicators for bison (Zeimens and Zeimens 1974).

Another possible means of sexing uses the height measurement of the mandible below M_3 (Reher 1970, 1973, 1974b). This is based on a principle that males have larger, more rugose mandibles than females. These measurements applied to bison populations yield bimodal distributions, but exact separation between males and females cannot be made. The method does appear to have a reasonably good validity, however.

Young animals, especially those less than a year old, are the most sensitive age indicators. All together, these studies can provide a close enough age determination to allow meaningful statements regarding the season of the actual site events. In other words, what was happening to animal populations can provide evidence for what was happening to the human population exploiting the animals.

A knowledge of seasonality results in a better understanding of prehistoric economic systems in operation. The structure of the populations of animals acquired may give some evidence of the limitations and preferences of human animal procurement activities. For example, a large bison kill containing only nursery herd animals can be interpreted in many ways. It could indicate the hunters' preference for the smaller and younger animals; it could also reflect the fact that the males do not generally associate with the nursery herd animals during the procurement period; or it could be interpreted to show that the males separated from the others when disturbed by the hunters. With hypotheses such as these to test, the investigator can turn to animal behavior studies for some of the answers to his problems.

Taphonomy and population dynamics studies can also be used to describe the evolutionary history of a species. Here a large population sample in datable context is necessary. It is vital in studies of this nature that ranges of variation in morphology and size of all ages and both sexes of the population be known. Future work will undoubtedly expand the usefulness of such studies for biological, paleontological, and archeological purposes.

In summary, there are many things the archeologist needs to know that can be extracted from studies of animal remains recovered in large kill sites. Studies in taphonomy and animal population dynamics can provide some of the evidence needed to reconstruct human cultural systems as well as the recent evolutionary histories of the various animal species. Bison kills have been the most productive in terms of data because many of the bison kill situations were communal efforts that resulted in the death of large segments of the population within a restricted time period and the remains were preserved in datable, recoverable contexts. However, any animal kill will provide the necessary data if enough ageable specimens are present.

The development of more precise age determination techniques for bison came about from the analysis of tooth eruption and wear of known-age animals from commercial and national park present-day herds, information on other animals (deer and antelope) were obtained from hunters and game management personnel. Tooth eruption and wear, especially of the molars, is systematic and predictable within limits that will provide time-of-year determinations, often within a few weeks. Premolars are useful but less systematic in their eruption schedules than the molars, and the incisors, probably the best indicators of age, are rarely preserved often enough in archeological contexts to be reliable.

The archeological investigator is especially concerned with the social implications of the communal animal kill. The distribution of food resources throughout most of the year on the Northwestern Plains required the humans to be dispersed in single or small multifamily groups in order to exploit the area most efficiently. As a result, the communal kills were probably the largest aggregations of people that commonly occurred there among hunting and gathering bands (Frison 1967b:36, 1970a:5, 1973b:77–80, 1974b:107). Band composition was determined by kinship and its extensions, and consolidating the kin group at intervals was an important mechanism for its continuing existence. It may have been that the economic benefits of communal animal kills were of no greater importance to hunting and gathering bands than were the social and possibly other institutionalized benefits.

8

Butchering and Processing of Animal Products by the Prehistoric Hunter

Culturally speaking, the pursuit and killing of animals were carried out at a level different from that of the activities occurring after the animals were dead. Hunting was a prestigious activity; butchering and processing the animal products were not. We can document that hunting was done by the men whereas butchering was largely performed by the women. On the other hand, every animal used as food by humans requires some special preparation to render it usable. Many things affect the degree and kind of preparation applied to a given animal. Some factors are cultural; some are dictated by the environmental; and some are determined by individual preferences. For example, ethnographic accounts of Plains bison hunters describe the immediate consumption of the warm, raw liver of a freshly killed bison as a delicacy. Its flavor was often enhanced by sprinkling the contents of the gall bladder over the liver. In our own culture, liver is regarded as a highly nutritious food, but only after it is properly cooled and cooked. Modern butchers are careful to remove the gall bladder, which they believe to be unfit for human consumption, so its contents do not contaminate the liver. Yet many people today categorically refuse to eat the liver of deer and elk (neither of which has a gall bladder), claiming the lack of a gall renders it inedible. There is no known record of prehistoric man making any distinction.

The prehistoric hunter usually stripped muscles from large animals by removing them as separate units from their origin to insertion. The units removed were further reduced by continued stripping along the grain of the meat.

The best method to cut up such strips is to clamp one end between the teeth, hold the other end with one hand, and cut the meat at right angles to the grain with a sharp stone knife in the other hand. Our own culture dictates that a similar animal be cut into designated units and that a steak has to be cut across the grain before it is cooked. Both processes accomplish about the same thing but in different ways. Both are culturally determined although some technological limitations were imposed on the prehistoric hunter.

Sometimes an item or process crosses cultural boundaries and assumes different meaning. Jerky is a good example. This product enjoys a surge of popularity today. It is available in strips at novelty stores, grocery stores, and especially at filling stations so that a traveler can purchase a strip or two to chew along the way. Jerky is made from the poorest possible meat, yet a premium price is paid for it. However, jerky properly made is quite flavorful. It should be chewed a long time so all the meat flavor can be extracted. A 1-oz piece of jerky is equal to about 10 oz of fresh meat. Present-day hunters often make jerky out of wild game as a way to process the meat and at the same time impress their nonhunting friends. To the prehistoric hunter, making jerky was a major means of preserving meat and reducing its bulk to make it more portable. Its use in our own culture is now largely a fad.

Killing an animal automatically obliges a hunter to perform subsequent operations—if the animal is to be properly utilized as food. Some limitations are imposed and leeway allowed by existing conditions such as time of day, time of year, animal size, and so on. For purposes of explanation, we can consider a mature female bison killed on a warm day in the fall of the year, a situation that regularly occurred. On the hoof the animal probably about 1100 lb, give or take 100 lb. The hunter had to open the stomach cavity and remove its contents within an hour or so of killing or there would have been danger of the animal beginning to sour. We know that flies were present prehistorically from thick layers of maggot cases preserved in bone levels in bison kills. On a warm fall day, fly eggs laid on meat in the early morning can hatch by sundown. The activity of flies is governed largely by temperature and is of less concern to the hunter later in the fall and into the winter as the weather grows colder.

Hatched fly eggs or, more bluntly, maggots in fresh meat—or even unhatched fly eggs—evoke strong negative reactions from the average American. As long as the flyblown condition had not progressed too far, the prehistoric group would not have been disturbed, since the meat could have been cooked and eaten without any danger. On the other hand, if the flyblown condition was allowed to continue, the meat would have become inedible within a short period of time. It should be remembered also that the average American regards maggots as completely repugnant whereas other cultural groups regularly use them as food.

However, prehistoric man had a solution to the fly problem. It took only a few minutes to construct a simple rack of small poles; a small tree or bush would suffice. The meat was cut into long, thin strips and hung to dry. As soon as a hard film formed, a matter of a few minutes in the hot sun, the flies could no longer lay eggs and if any had been laid they would be unable to hatch. The meat would have been black with flies, as many eyewitness accounts tell us, but their efforts at harming the meat would have been checked. Again the average American would be greatly disturbed at being asked to eat meat after seeing it covered with flies. The same American might also give up the great American institution known as the hamburger and hot dog if he were to visit certain meat processing plants and see the kinds of animal products that sometimes go into hamburger and frankfurters.

There were many different kinds and different degrees of prehistoric butchering depending on the immediate situation. A communal kill presented one set of problems; a single hunter with an animal far from camp and the rest of the group had different problems. Since most of this book deals with the communal hunting situation, it might be well to reflect momentarily on the plight of the lone hunter. Sometimes an animal was field dressed, which means that the hide was left on but the animal was split open and its innards removed. If the animal, let us say the 1100-lb female bison mentioned earlier, was to be left on the ground overnight or for any length of time with the hide on during warm weather, some provisions had to be made to ensure proper cooling or the animal would begin to sour, usually from the neck down the spinal column and eventually into the entire carcass. And there is no mistaking sour meat; one whiff at close range is nauseating and no one is going to eat it.

In order to prevent souring, the rib cage must be propped open and the front legs spread wide. As an added precaution the shoulders of the animal should be elevated slightly off the ground. The neck should also be opened and the tongue and windpipe removed. Many a fine animal sours because the hunter fails to open the throat completely and remove all the windpipe when he field dresses an animal. Another added precaution against souring is to cut open the muscles between the front legs and the rib cage to allow air to circulate. These precautions are not as critical in below-freezing weather, but even then, souring of large animals has resulted in the loss of a lot of good meat. Sometimes part of an animal can be saved if the souring is detected in time and the bad part cut out. Small animals usually present no souring problems because of reduced bulk and more rapid cooling. Also it is a relatively simple matter to hang a smaller animal or simply elevate it over a bush, rock, or anything to get it up off the ground to allow faster cooling.

Sour meat is a problem that few of us today are familiar with or for that matter have even heard of. Most meat today is handled through slaughterhouses that are federally inspected regularly to ensure sanitary conditions. Animals are cooled in temperature-controlled rooms and the meat is hung and aged until the muscles relax properly before it is cut and wrapped for human consumption. Sour meat cannot occur under these circumstances but it is a real problem lacking these facilities.

The prehistoric hunter faced a myriad of problems and decisions. It required a lot of effort and know-how to cope with the commonly occurring but relatively simple matter of the 1100-lb female bison that had to be field dressed. First, the hide had to be slit from the base of the tail to the throat. In doing this, care had to be exercised to avoid cutting into the paunch or intestines, since the quality of the meat is not enhanced if contaminated by the stomach contents. The rib cage had to be opened. This is a simple matter if you can use a steel hatchet to chop through the sternal elements. However, the butcher using a stone knife and chopper had to go slightly to one side and separate the costal cartilages from either the sternal elements of the ribs depending upon the individual butcher's preference. The hunter might have preferred to separate the pelvis at the pubic symphysis in order to remove the anal canal more easily and facilitate opening the animal to allow better cooling. Again this is a simple process with a steel hatchet, less simple with a heavy steel knife, and a real problem with a chipped stone knife. There is evidence to suggest that the prehistoric hunter crushed the bones in the area of the pubic symphysis with a heavy hammerstone, which functions quite well. The age of the animal affects this process also. Ossification, which affects the ease of separation of both the pubic symphysis and the sternal elements and costal cartilages, would have been less advanced on an immature animal than on a mature one.

With the animal slit open, the innards were ready for removal. The hunter held the windpipe and cut out the tongue at this time if he so desired. Using the windpipe as a handhold, he began to strip out the insides, cutting them loose as he went. He could retrieve whatever parts he wanted, such as the heart and liver, as he went, or he could wait until the whole mass of innards was removed from the carcass and then salvage them. The diaphragm had to be cut, and the kidneys could have been left in the animal or removed according to the individual preference of the hunter. Some hunters like to bleed an animal as soon as possible, whereas others do not bother. Sometimes this depends on the nature of the wound that killed the animal. A spear in the rib cavity causes profuse internal bleeding; the same thrust in the stomach or spinal column results in little or no bleeding. The average American today feels an animal should be properly bled but the prehistoric hunter was not likely to be upset by bloody meat and might have considered it an asset rather than a liability.

After removal of the innards, the animal was ready to be propped open to cool. First a stick of proper length was placed between the ribs. Lacking trees or brush of proper size, a condition not uncommon to the open plains, the hunter could have used a rock. But even rocks can sometimes be difficult to locate and the hunter may have had to cut off the animal's foot and use it to prop the animal open. A stick, rock, or whatever was available could have been used to roll the animal over and elevate the shoulders free of the ground if the hunter felt this was necessary. Because of its high hump, a bison is almost impossible for one person to roll over or keep on its back. An animal with less hump, such as an elk, is relatively easy to place on its back. A small stick or stone could be used to block the carcass so it would remain in that position, which is the best for cooling.

The hunter could not ignore carnivores and scavengers if he was to leave the animal for any length of time. Eagles, magpies, ravens, and other birds can consume a surprising amount of meat and ruin much more. Coyotes are usually suspicious of a carcass the first night, while human scent is still strong; but bear, the various cats, and others will gorge themselves whenever the opportunity presents itself. Brush piled over the carcass will deter the birds but not the animals. Many a hunter returns to his kill to discover it has been spoiled or has undergone various amounts of destruction by birds and animals.

In other words, just because the prehistoric hunter killed an animal did not mean that his efforts ended. Pursuing and killing the animal was and still is a source of enjoyment and satisfaction to the true hunter but afterward he is obligated to a good deal of effort to realize the benefits of the kill. Every kill and butchering situation is unique, so the prehistoric hunter continually added to his basic skills and hunting knowledge. This uniqueness makes every kill site a challenge to the investigator. It also makes it difficult for the investigator to define an exact butchering process for any given site, since there are so many unknown variables affecting each kill and butchering situation. On the other hand, the basic butchering procedures and processes did not change greatly until the introduction of metal tools.

So much for philosophical reflections on the prehistoric person who completed a successful hunt and was then faced with the problems of caring for the meat so that it would not be wasted and its quality would not suffer. White (1952, 1953, 1954) initiated systematic studies of prehistoric butchering of large animals on the Plains. His approach was that prehistoric animal carcass handling and utilization could be interpreted from the skeletal units recovered in archeological sites. Much the same approach is still being used, although modified somewhat by different investigators.

We know that prehistoric man on the Plains was an able butcher and he used a simple but functional set of tools. The communal kill placed demands on the butchers that individual hunting did not. Animals are easier to butcher when still warm from natural animal heat. As the animal cools the hide is harder to remove, the appendages stiffen, and the animal carcass becomes difficult to manipulate. It is possible (but not proven) that the initial butchering of animals in a communal kill was also communal. A cooperating team of two or three can butcher a large animal much more efficiently and quickly than the same two or three operating separately.

Butchering animals the size of mature bison is hard work using a steel knife and axe. It is harder yet using a chipped stone blade, a stone chopper, and a hammerstone. Different motor habits are required with a stone knife than with a steel one. Grasping a stone blade brings into play an entirely different set of muscles than the same action with a steel knife. However, when the proper muscles have been developed, a good deal of the supposed superiority of a steel knife over a stone one disappears.

Several investigators, myself included, have determined through intensive studies of bison kill sites that bone choppers and fleshers were an important part of the butchering tool assemblages in most but not all sites. Bison tibiae

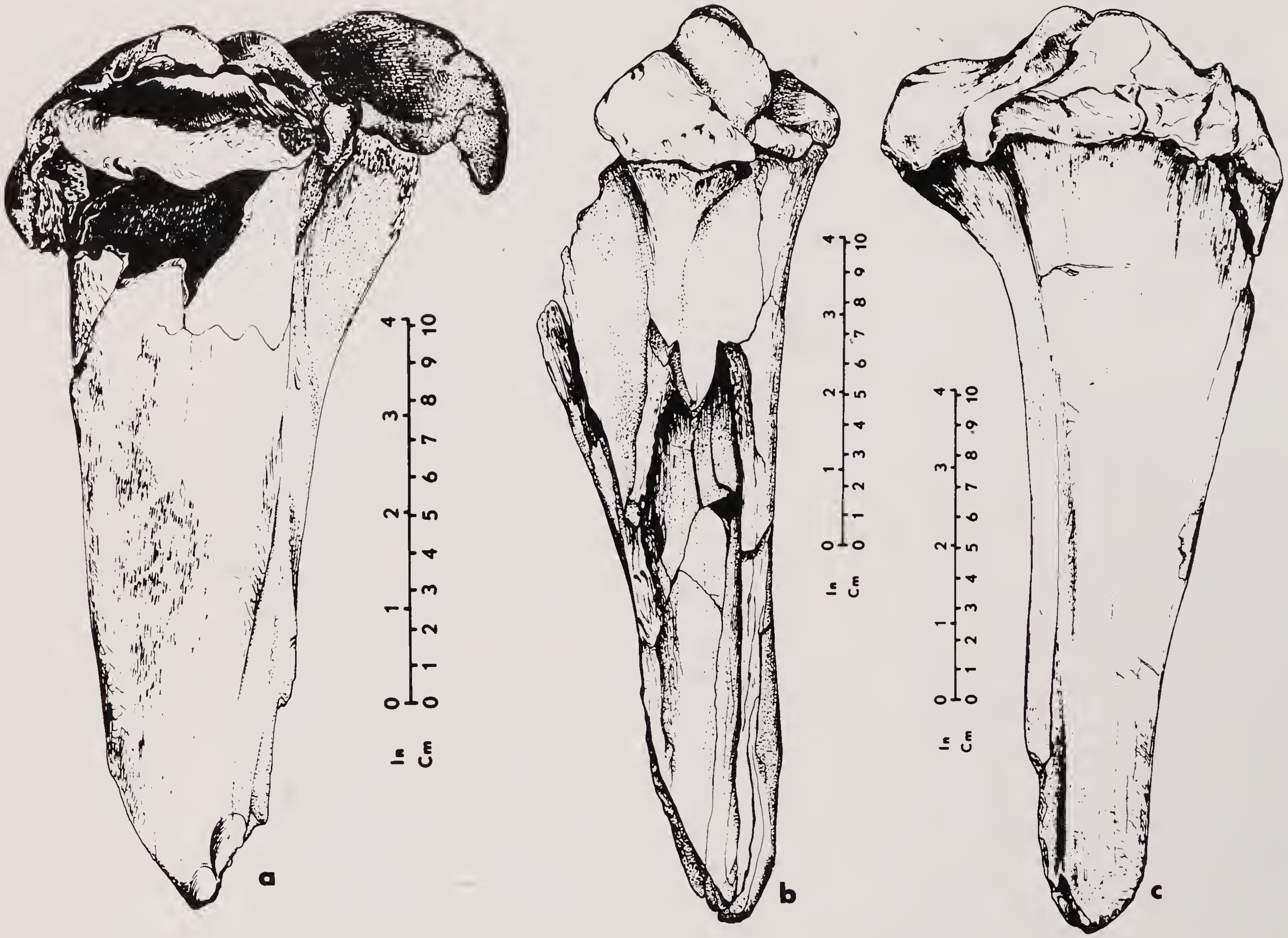


FIGURE 8.1. Bison tibia choppers from the Casper site.

especially and femora to a lesser extent were systematically broken at an angle across their diaphyses. If properly done, this formed a heavy, serviceable chopper with a sharp point and good handhold. The green bone point survived a surprising amount of intensive use such as was needed in chopping loose muscle attachments. In some ways the bone chopper was superior to a stone one because it was more difficult to maintain a sharp point or edge on the latter that would survive much intense chopping use. On the other hand the bone chopper was worthless as a tool for breaking heavy long bone; it was used only to chop into the relatively soft muscle attachments. Bone choppers of this nature appear in communal bison kills over a period of at least 10,000 years (see, for example, Frison 1970a, 1973b, 1974b). The ones at the Casper site (Figure 8.1) were identical to those at the Vore site (Figure 8.2a). Other bison skeletal parts were modified into chopper tools at the Vore site. Among parts used were the pelvis (Figure 8.2b), horn core (Figure 8.3), calcaneus–astragalus–metatarsal (Figure 8.4), distal tibia (Figure 8.5), and others. Bone butchering tools left distinctive marks on bones (see, for example, Figure 8.6).

Another bone butchering tool, which was developed more than 10,000 years ago and maintained its popularity through the remainder of prehistoric butchering of bison on the Plains, was the bison humerus flesher. The tool was simple to manufacture. A right-handed person chose a left humerus because the olecranon fossa formed the proper handhold. The left-handed person chose a right humerus. To prepare the tool, the proximal articular end was removed and the entire circumference of the bone around the break was given a toothed edge by breaking out sections of bone (Figure 8.7a). The resulting tool is believed to have served as both a skinning tool and a fleshing tool. The distal end served as a handle and the sharp prongs sunk into and firmly grasped the hide so that it could be pushed loose from the carcass. It accomplished this and left the hide clean of flesh that was ordinarily difficult to remove and it did not puncture or cut the hide. It is vaguely reminiscent of a modern tool used in skinning large animals—a disk-shaped piece of metal that is power-operated. The humerus

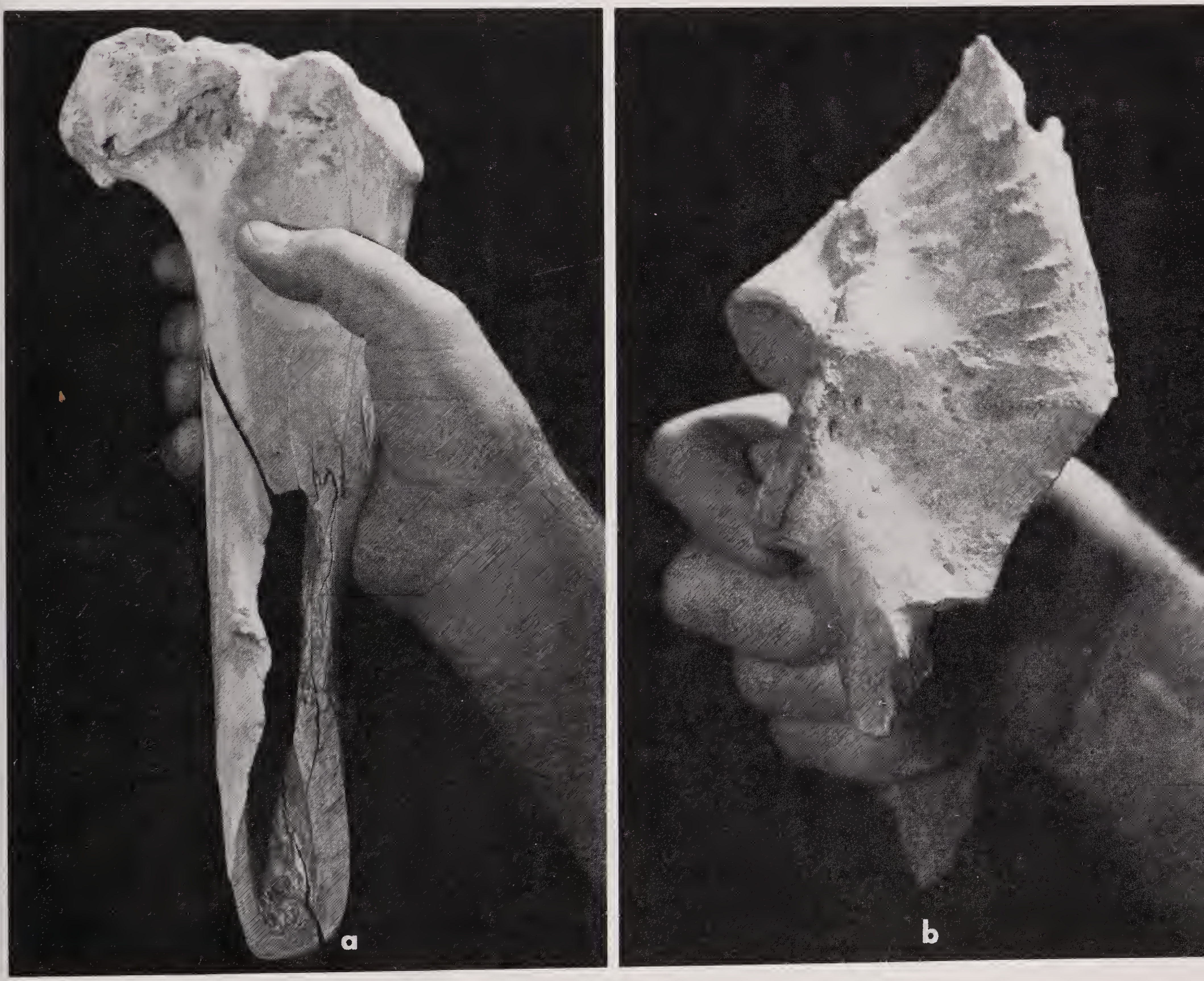


FIGURE 8.2. Bison tibia (a) and pelvis (b) tools from the Vore site.

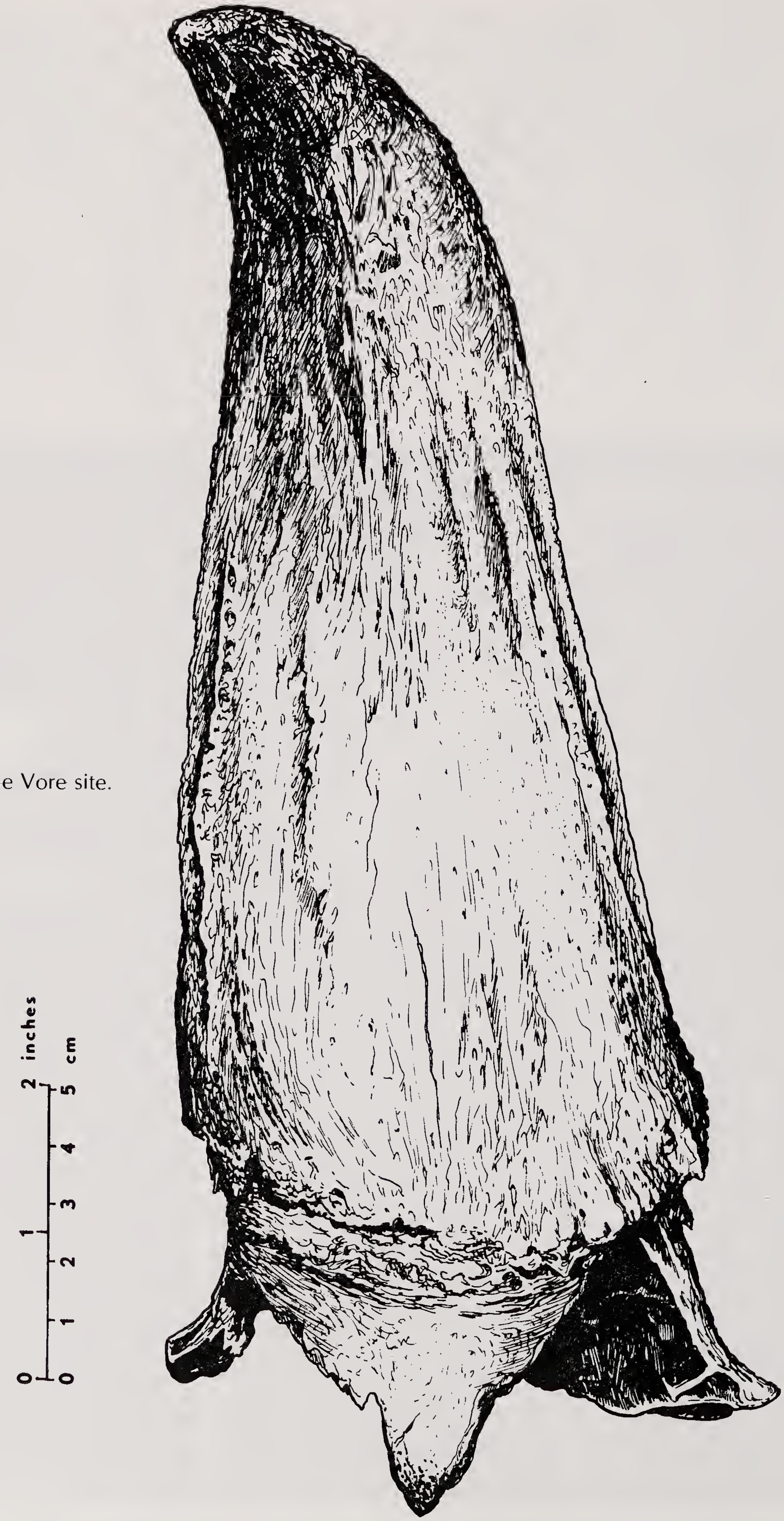


FIGURE 8.3. Bison horn core chopper from the Vore site.

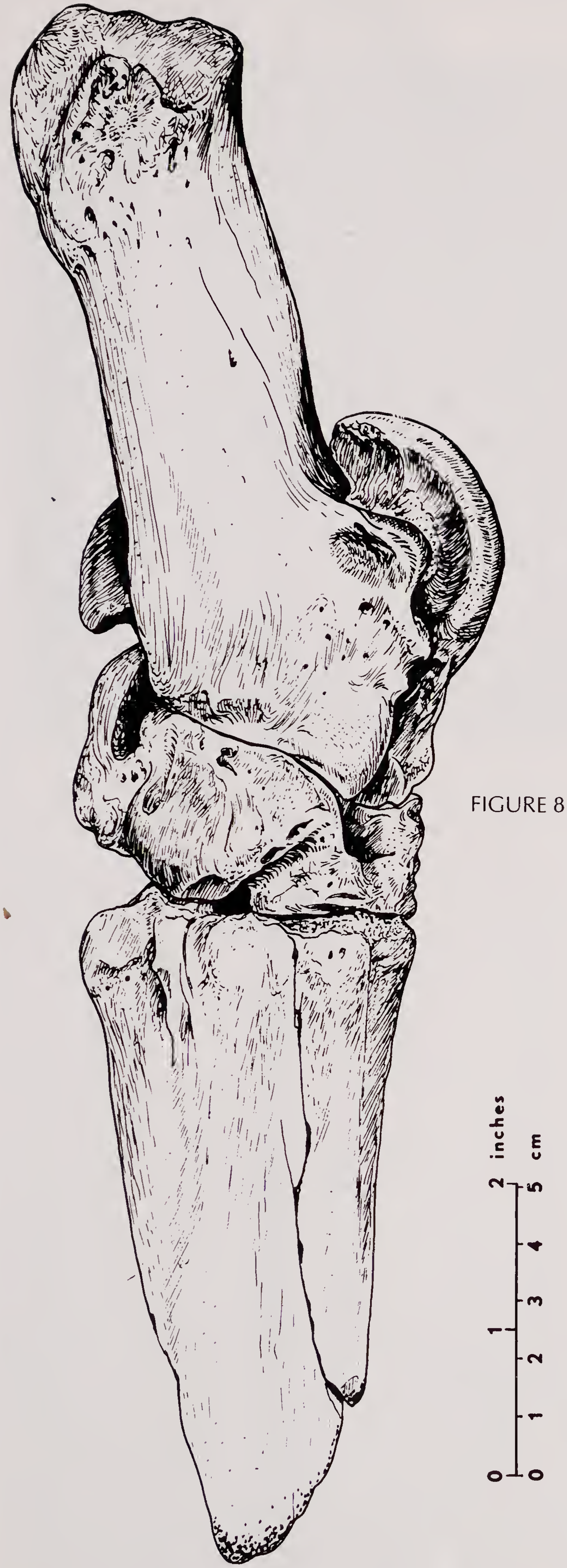
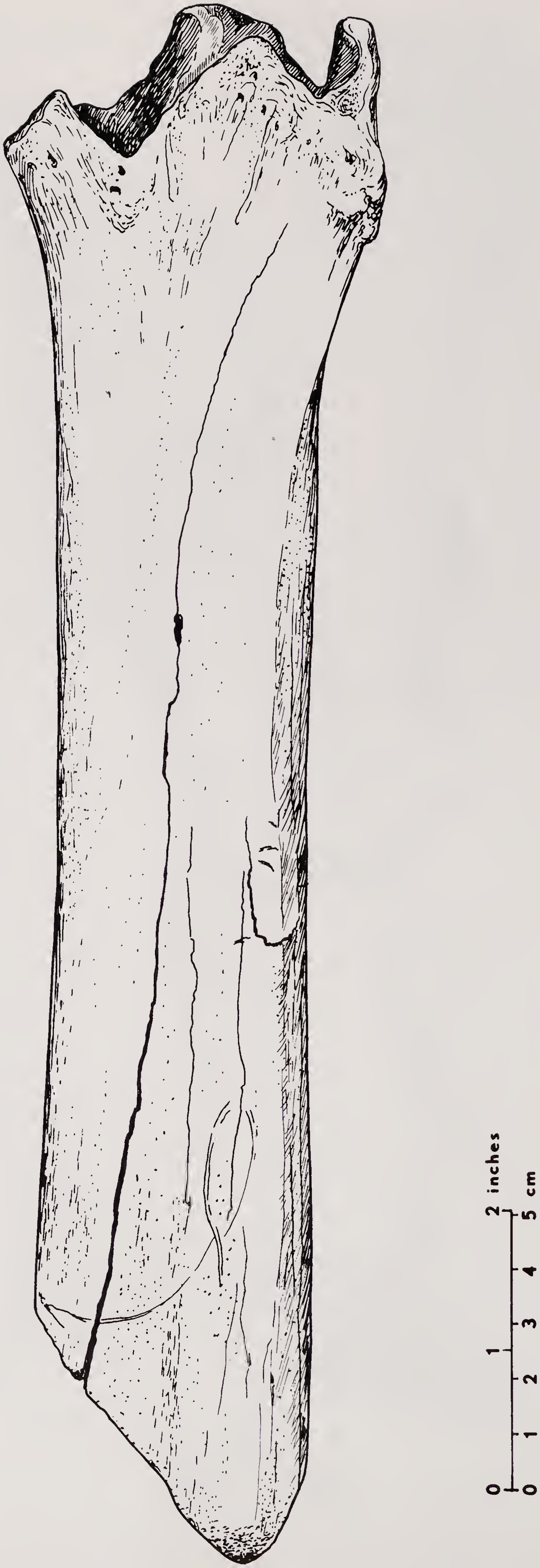


FIGURE 8.4. Bison astragalus–calcaneus–metatarsal chopper from the Vore site.

FIGURE 8.5. Bison tibia chopper from the Vore site.



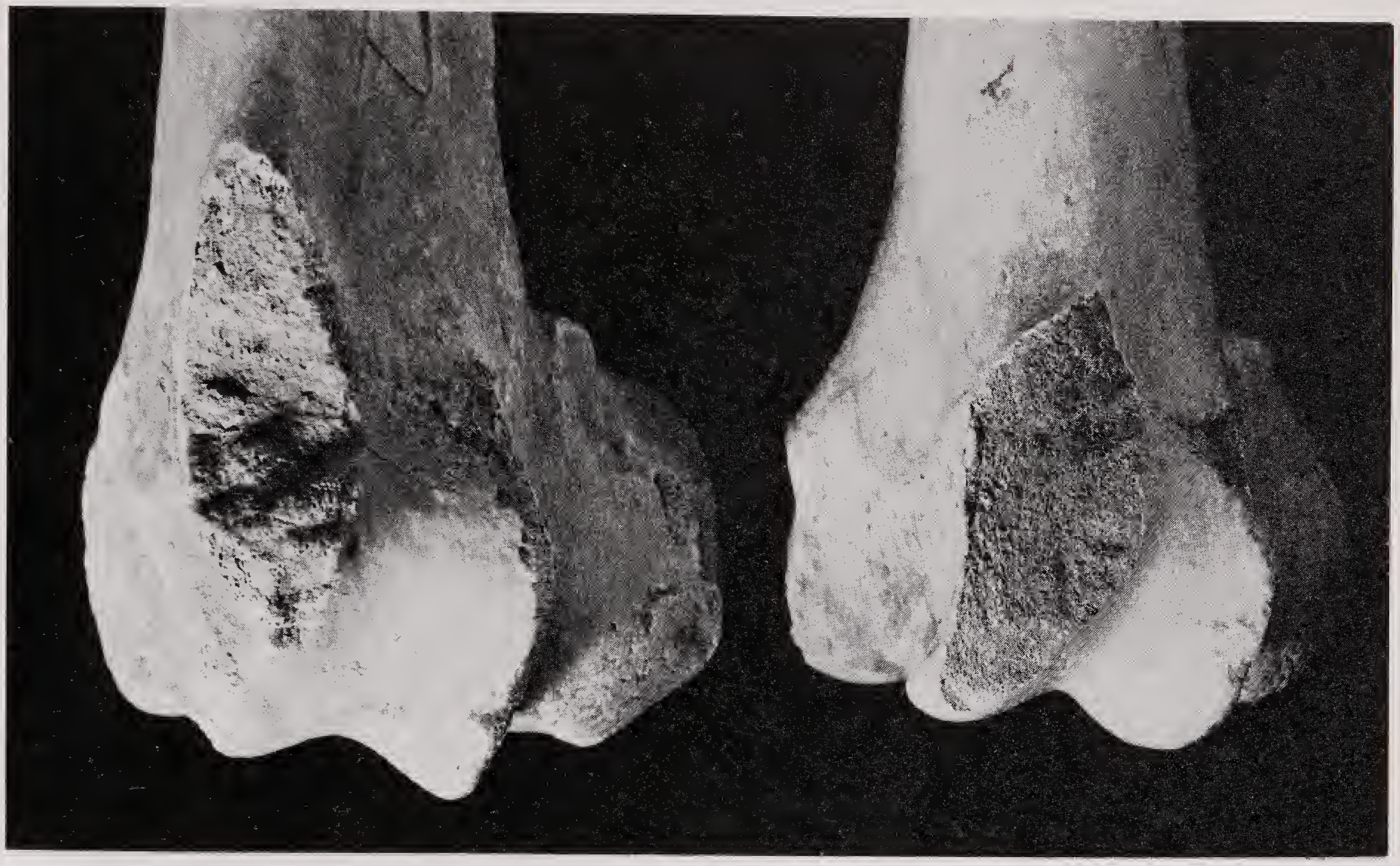


FIGURE 8.6. Marks of a bone chopper on bison femora.

flesher may also have been used to remove flesh from bones, a task for which experimentation proves it to function quite well. A word of caution to investigators—carnivores can chew the ends of long bones into such shapes that they appear to be tools but are not (Figure 8.7b).

The cutting tool in communal bison kills was usually a large percussion flake requiring little preparation other than the sharpening of the cutting edge and the dulling of the part held in the hand (Figure 8.8). This type of tool was efficient and easily resharpened. The user felt little remorse in discarding it when it was worn out or broken because little effort went into its manufacture and a new one was easily obtainable. Tools of this kind were usually sharpened unilaterally on the back of the flake and only occasionally were they known to have been sharpened bilaterally. These tools appear almost without exception in prehistoric bison butchering contexts on the Plains from Folsom to historic times. They are functional for all cutting requirements in butchering a bison but are not equal to a steel knife. Many kill and butchering sites have produced only small numbers of these tools, but the use of a great many more can be indisputably demonstrated by the presence of flakes removed in the process of sharpening tools no longer present (see, for example, Frison 1967b, 1974b).

Hammerstones and stone choppers also appear in prehistoric bison butchering contexts. Breakage of bones was common and the amount and kind depended upon the butchering process employed in any given site. In some cases joints were separated by cutting the ligaments; in other cases the bone was crushed or broken on one or both sides of the joint. Hammerstones were

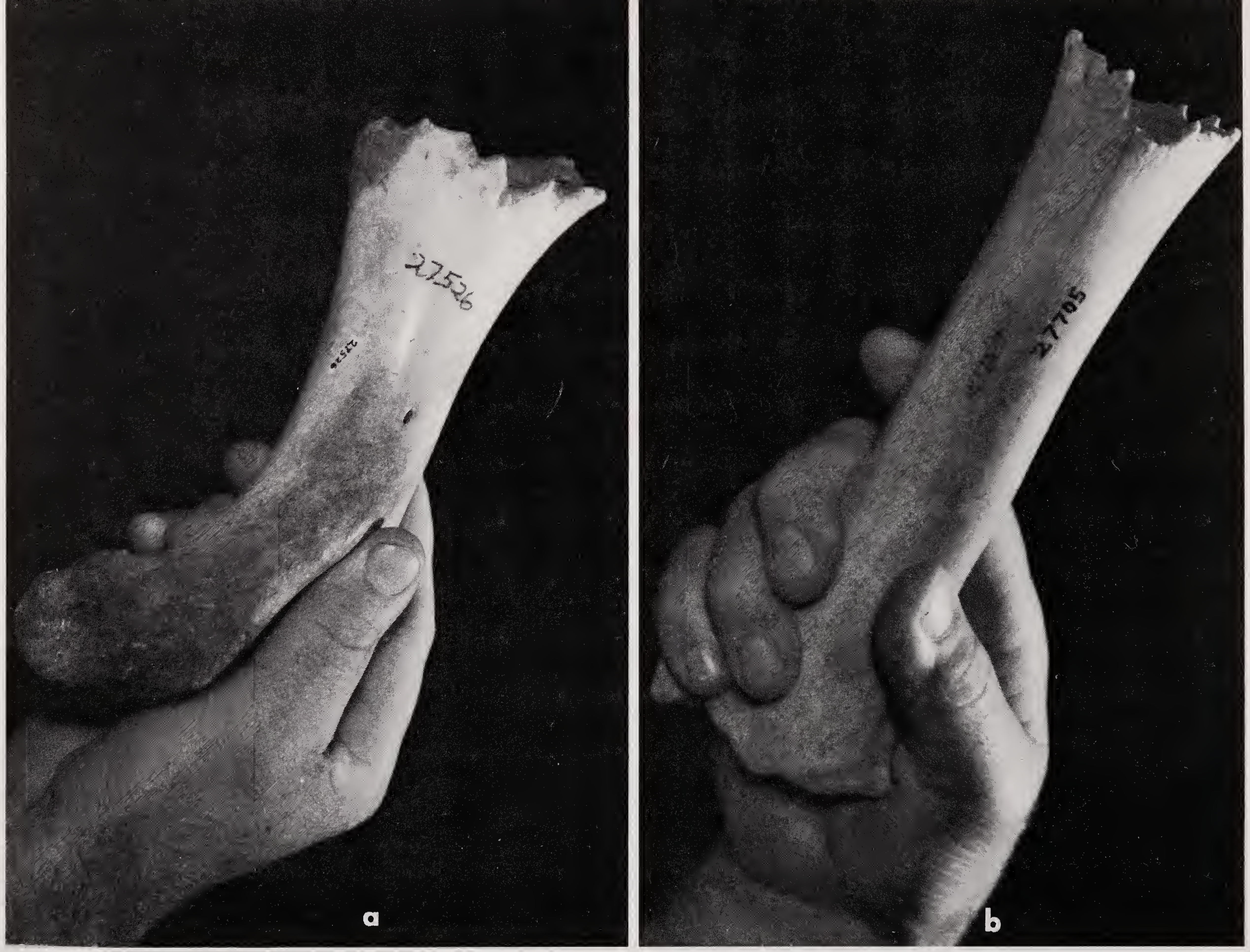


FIGURE 8.7. Bison humerus flesher (a) and a carnivore-chewed bison radius (b) from the Vore site.

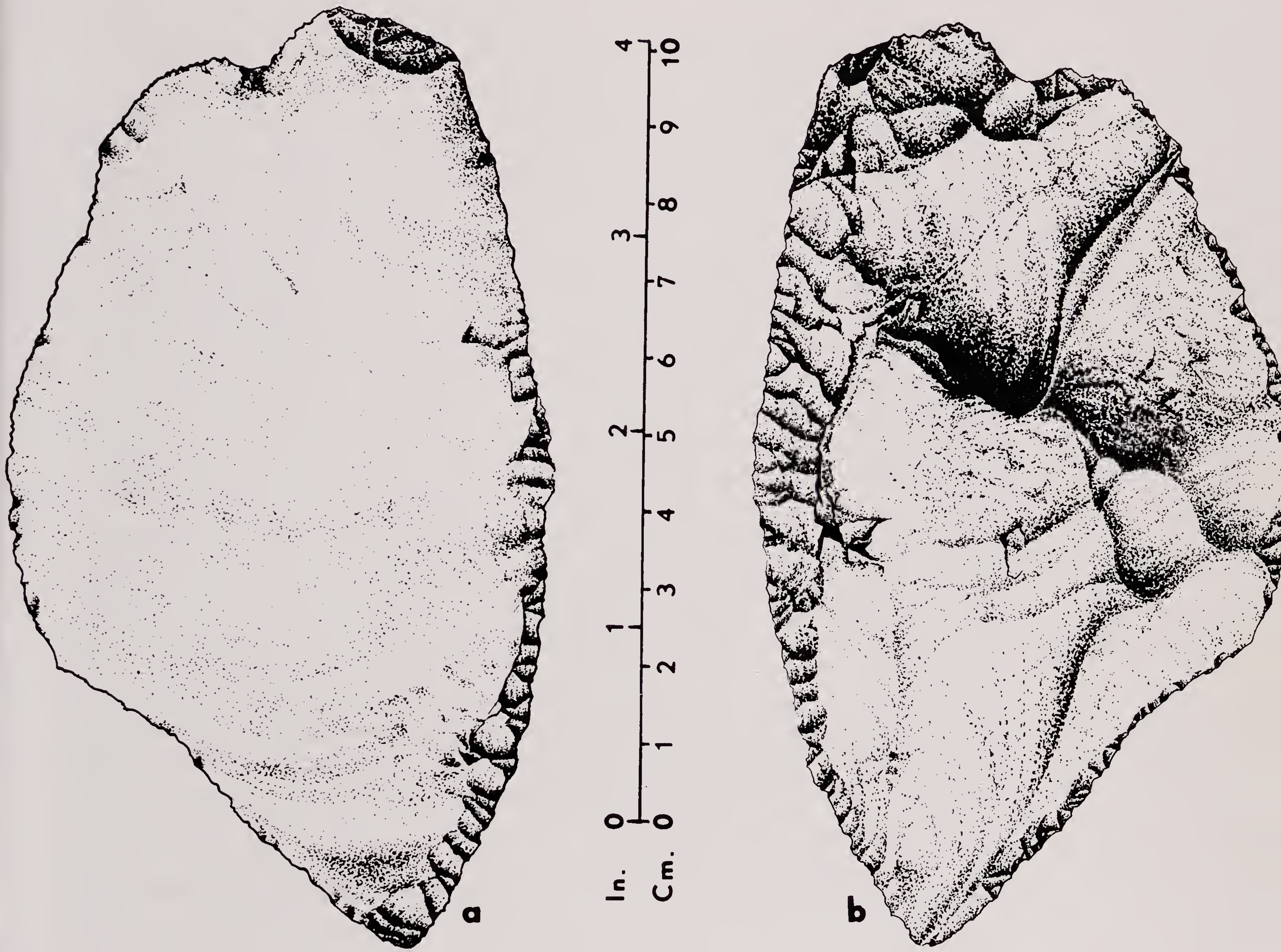


FIGURE 8.8. Typical chipped stone butchering tool from the Glenrock Buffalo Jump. Usually these kinds of tools are not resharpened on the flake face.

usually unmodified river cobbles of the desired size and shape. Sometimes one end of a flat river cobble was flaked for a sharp edge or point. Muscle attachments were sometimes removed with a stone chopper, sometimes with a bone chopper—even in the same site. This may have been the result of differential availability of raw materials or the preferences of the individual butcher.

It should be emphasized again that during at least 10,000 years of prehistoric bison butchering on the Plains, the basic process changed little. Some groups preferred one tool type or assemblage over another. Some groups favored a stripping and dissecting technique whereas others leaned toward stripping meat and breaking the bones. We are far from being able to analyze the butchering process in any given site and make meaningful statements about the time period or cultural affiliations involved. An exception might be something like the practice of opening the brain cavity from the front, which seems to be a diagnostic of the Late Prehistoric period on the Plains, and may have been for ritual purposes rather than for functional reasons.

However, I believe that a good deal about actual prehistoric butchering processes can be described, using interpretations from marks on bones, the composition of bone units remaining in kill and butchering sites, experimentation in butchering animals, tool assemblages, and historic accounts. Unless the animal is to be field dressed, a subject already discussed at some length, the first consideration in butchering is either partial or complete skinning. Before muscles can be stripped, the hide has to be removed. A large animal such as our 1100-lb female bison was very likely completely stripped of muscles on one side before the other side was skinned; regardless, the butchered side first had to be skinned. Some disagreement exists as to whether the hide was ordinarily slit up the belly or the back. If the hide was to be removed in a single piece, slitting the hide up the back was a poor choice since here the hide is thicker, the coat of hair is heavier, the animal is more awkward to hold, and the necessary cuts down the legs are difficult. The easiest way is to slit the hide up the belly and the insides of the legs. The best known way to make the initial holes in the hide is to cut into the diaphysis of the metatarsal and metacarpal. There is evidence to support this observation in the form of tool marks on significant numbers of these bones from several sites. Once the butcher made a hole in the hide large enough for him to get his finger in, the hide could then be stretched taut and the process of slitting the hide the remainder of the way up the leg was not difficult, as long as the stone knife was kept sharp. The average stone knife soon loses its keen cutting edge when used against bison hide and must be resharpened regularly.

Another spot on the bison carcass where we think that holes were cut into the hide to begin slitting the hide down the throat is located on the ventral part of the mandible directly below the diastema. Transverse cutting-tool marks regularly appear here; these are different from other cutting-tool marks that appear along the medial side of mandibles and are believed to have resulted from cutting muscles to remove the tongue.

Once the hide was removed from one side of the carcass it was laid flat on the ground so meat could be piled on it. Muscle stripping began on the front leg. The most important muscle attachments were the lateral and medial tuberosities on the proximal end of the humerus. These were chopped loose and used as handholds to strip the suprascapular and subscapular muscles respectively. The olecranon was often chopped loose also and used to strip out other front leg muscles. The front leg was removed entirely and attention was then turned to the hind leg.

Several key muscle attachments determined the method of stripping the meat from the hind leg. One of these was the patella, which was loosened by chopping into the trochlea on the distal end of the femur. Evidence indicates this was possible using either a stone or bone chopper. By using the patella as a handhold, the hunter could strip the muscles up to the major trochanter of the femur, which was then either broken or chopped loose. Muscle stripping then continued on to the tuber coxae and this was also chopped off. The muscles along the back between the ribs and dorsal spines were then stripped, aided by cutting along the dorsal spines and ribs with a stone knife. Cutting-tool marks are usually found here. The stripping could continue to the base of the skull if desired. When stripping was completed, the butcher had a strip of meat about 7 feet long. On our 1100-lb mature female bison, this strip weighed about 45 lb and contained some of the choicest meat on the carcass.

Next, the muscles on the rear of the leg were stripped by chopping loose the tuber ischii and using it as a handhold. Quite regularly the tuber calcis was broken or chopped off and used to strip muscles from the lower part of the hind leg. Medial muscles of the rear leg could have been removed with the posterior ones or separately by crushing the bone in the area of the pubic symphysis and using this as a handhold. The hind leg was now essentially free of meat and could be removed if so desired by cutting ligaments at the head of the femur and then levering it out of the acetabulum. A common alternative treatment of the pelvis consisted of breaking the pelvis in all three places distal to the acetabulum. The sublumbar muscles were stripped out and usually but not always the transverse processes of the lumbar vertebrae were broken off in the process and removed with the meat. Both quarters were now completely stripped of muscles except for the ribs and brisket.

All evidence points to the fact that the brisket was a greatly desired cut of buffalo meat and was removed in one piece by chopping off the distal ends of the ribs. The ribs were in turn removed by chopping or breaking them off a short distance from the vertebral column, leaving the rib heads and short sections of the ribs still articulated. One of the most common butchered units left in bison kills was a section of the vertebral column with ribs still attached—suggesting that there was no further use for it. Some of the outside layers of meat on the ribs may have been stripped before the ribs were chopped loose. Commonly, the number one rib and less often the second rib were not included with the rib unit. The neck muscles were removed and in the process the ventral branches of the transverse processes of the cervical vertebrae were chopped or broken loose.

At this point one side of the animal was completely butchered except for the hump, which was probably removed at this time by chopping off the dorsal spines of the thoracic vertebrae. Sometimes this was done close to the base of the neural spine on the vertebrae, but just as often it was done several inches distal from this. The skull could also be removed at this time, or the hunters could have waited until the other side of the animal was stripped. Skulls were removed by cutting ligaments or else chopping into the wings of the atlas; a sharp twist then left the skull free of the vertebral column. Mandibles were sometimes but not always removed from the skull. Splitting of skulls, especially those from immature animals, was common, and was accomplished by chopping into the palate with a stone chopper.

The muscle-stripping process was repeated for the opposite side of the

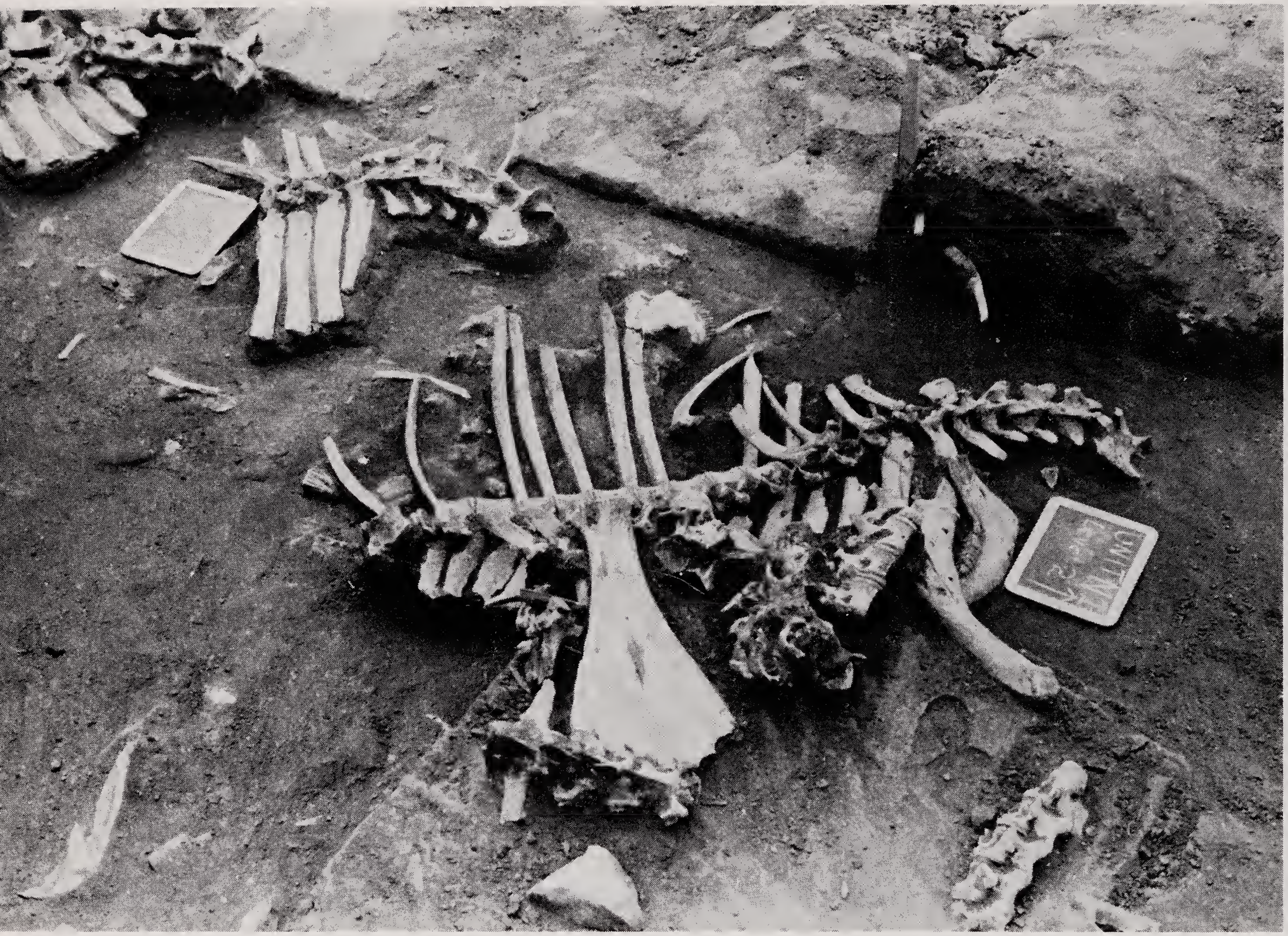


FIGURE 8.9. Butchered bison carcasses at the Vore site.

carcass and the animal was then completely butchered. All that remains archeologically is usually a pile of bones and an occasional tool (Figure 8.9). For more detailed descriptions of bison butchering the reader should go to other sources (for example, Frison 1970a, 1973b, 1974b; Wheat 1972). I am fully aware that there were many variations of this general butchering process and that there were alternatives open to the butcher at various points along the way. Once more it should be stressed that each butchering situation was unique and required slightly different techniques.

EXPERIMENTAL BUTCHERING USING STONE AND BONE TOOLS

Experimental butchering has been a means of testing a number of the hypotheses on butchering processes and techniques that arose as the result of

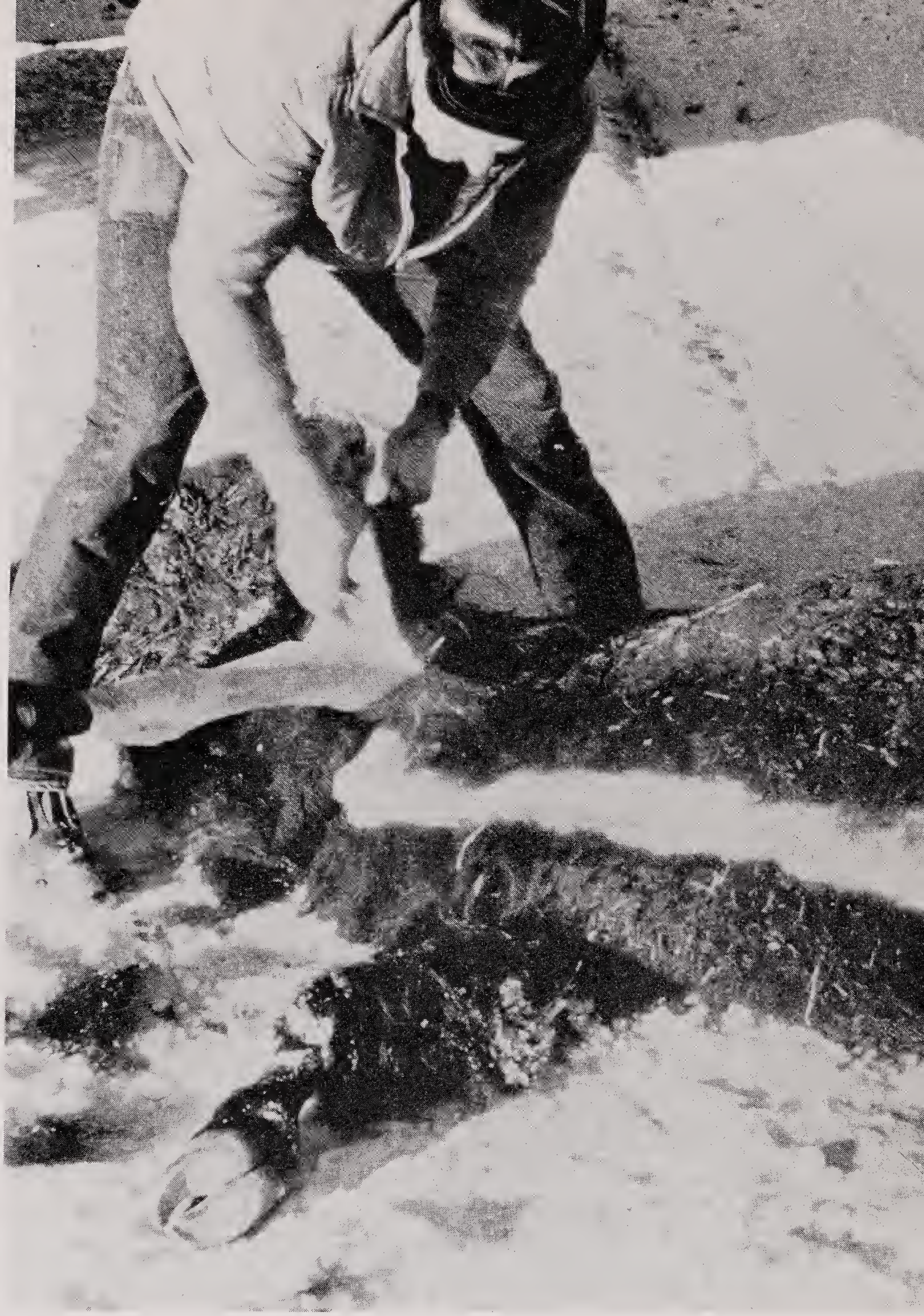


FIGURE 8.10. Experimental bison butchering.

observations made in prehistoric bison kill and butchering sites. It has also been the source of many new ideas on butchering and tool use. I strongly believe that there is no known substitute for taking a prehistoric stone and bone butchering tool assemblage and applying it to animals (Figure 8.10) until one is proficient at butchering—if one wishes to become familiar with prehistoric butchering. It may not be possible to re-create past conditions exactly or prove hypotheses beyond any doubt but actually using the tools is a good way to understand the limitations imposed as well as the possibilities offered by a tool assemblage during butchering.

A stone flake or flake tool is surprisingly efficient as long as it is kept sharp and as free as possible of grease and body fluids. Animal grease increases the gripping pressure necessary to hold a tool properly during intense use. The greasy tool and the butcher's hand can both be wiped clean on the animal's hair or a handful of grass. Wrapping a handful of long bison hair on the part of the tool that is held in the hand helps also. The pain that results from gripping a tool unnecessarily tightly as a result of grease can become agonizing.

This immediately raises the question of tool hafting and why the prehistoric butcher did not simply use a hafted tool. The question is often posed also as to the use of projectile points as butchering tools. A properly hafted stone knife is easier to use than a hand-gripped one. On the other hand, flake and blade tools used in bison butchering were not amenable to hafting. Stone has little structural strength compared to steel and a long handle cannot be attached to a stone knife unless a suitable means of attachment is provided. The handle must be well supported and properly attached to withstand the pressures of intense butchering. This sort of haft can be provided but consider also that the stone knife is rapidly dulled in some butchering operations so that the attrition rate through use and continued sharpening and breakage is extremely rapid. The butcher soon has a hafted tool that is no longer of any use, but one in which he has a large investment in terms of time, effort, and materials. It is better for him to use a large hand-held flake or blade tool that is functional for intensive butchering and to discard it when it is broken or worn out.

The projectile point and its accompanying shaft and bindings were designed to penetrate on impact with an animal. Most bison kill sites demonstrate that projectile points were reused whenever possible, but as projectile points, not as knives. I have yet to find convincing evidence that the same hafted projectile points used in killing animals were relied upon to any significant extent in heavy butchering. It is not difficult to understand the reasons. A projectile point, its wooden haft, and its sinew bindings were simply not designed for that purpose. The pressures of thrust are altogether different from the pressures resulting from heavy butchering. The shaft and the sinew bindings can be strengthened to the point where they will withstand this kind of abuse, but when they are so strengthened the haft and binding areas cover so much of the point that its penetrating qualities are hampered. Many kinds of activity areas yield abundant evidence of the use of projectile points as tools, but these tools were not the ones chosen for initial heavy bison butchering in communal kills.

Buffalo hide is tough but not as tough or as thick as the hide of the genus *Bos*. A sharp stone knife slices quite easily through bison hide but its keenness is soon lost. As the knife gets duller, more and more pressure is needed to force the tool against the hide, which in turn requires a tighter and tighter grip on the knife. Ultimately the only solution is to sharpen the tool. On the other hand, for actual skinning once the hide is cut, the stone knife is about as useful as a steel one. In fact, the stone knife that is slightly dulled so that it will not slice into the hide but still severs the tissues holding the hide to the animal is a superior skinning tool.

Bone tools were an important part of the butchering tool assemblage in many prehistoric sites. However, it is important not to misinterpret their use and above all not to identify specimens as bone tools that in reality are not bone tools. Unfortunately for the archeologist, bone tools used in most butchering contexts were of an expedient nature and their manufacture involved much the same breakage as occurred in some ordinary butchering processes. As a result, most of the identification as a tool is from evidence of use rather than manufacture. Only when bone preservation is good can positive identification as tools be made. Some of the tool identification in Paleo-Indian sites resulted from studies made in Late Prehistoric period sites where preservation was good and positive identifications were possible.

Rodents and carnivores are prone to chew on bones and antlers, and the patterns they leave are usually distinctive enough to be identifiable. As already mentioned, certain chewing patterns by carnivores might be interpreted as deliberate tool manufacture or use or both. It is also possible that the bone tool may have attracted the attention of carnivores and rodents more so than other bones, probably because of the residue that built up on the tools from use.

Keeping these ideas on tool use in mind, we can refer once more to a typical 1100-lb female buffalo. This animal was completely butchered following the procedures just described and using a tool assemblage as nearly as possible identical to that recovered from the Glenrock Buffalo Jump (Frison 1970a). The animal was culled from a herd after losing her calf and the whole butchering process was performed under the watchful eye of an official meat inspector, who later approved the butchered products for human consumption. The bones of the animal (except for the skull) were later cleaned and checked for evidence of tool use. We found most but not all of the cutting, chopping, and hammerstone marks that had been recorded on bones from the Glenrock site. Weights for all of the separate butchered units were recorded and the total came to 348 lb, somewhat short of the general rule that the average mature female bison should yield about 400 lb fresh meat.

Another project in experimental butchering is an attempt to quantify what happens to the working edges of tools as the result of use and to explore various alternatives in the butchering processes. As with most tools that require continual maintenance, learning to prepare butchering tools for use is just as important as learning how to use them. We have found that it is difficult to analyze the working edges of tools in order to determine task-specific aspects of butchering. Butchering covered such a wide range of tool use activity and made so many different demands on a tool that its effects on working edges are impossible to separate in a task-specific sense. A tool no longer functional for one kind of butchering use may be perfectly functional for other uses. Certain butchering tasks result in a relatively high attrition of tools whereas others do not. It is suggested from a large body of evidence that the high tool-attrition aspects of butchering were taken care of with special classes of easily made tools that were used up quickly and then discarded. A tool may have a short life in a high attrition situation, but without modification it may then have a comparatively long life in another situation. For example, a tool that has been dulled quickly in cutting hide may then be used for some time in skinning or cutting flesh.

Slitting the heavy hide of a buffalo is a high tool-attrition task. In my experiments none of the common cherts, quartzites, or obsidians will hold an edge for very long when used in cutting open the hide especially if it is dirty as

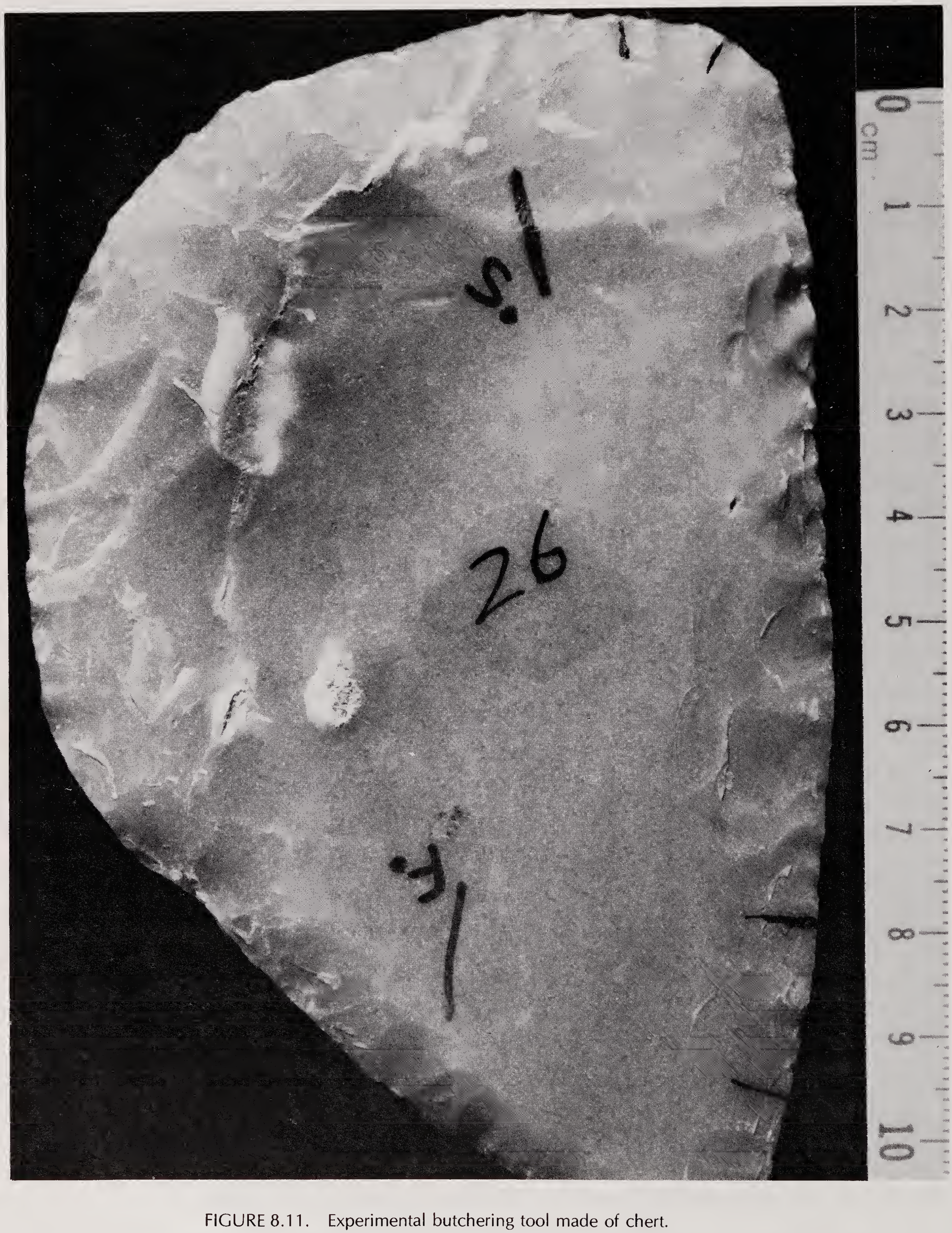


FIGURE 8.11. Experimental butchering tool made of chert.

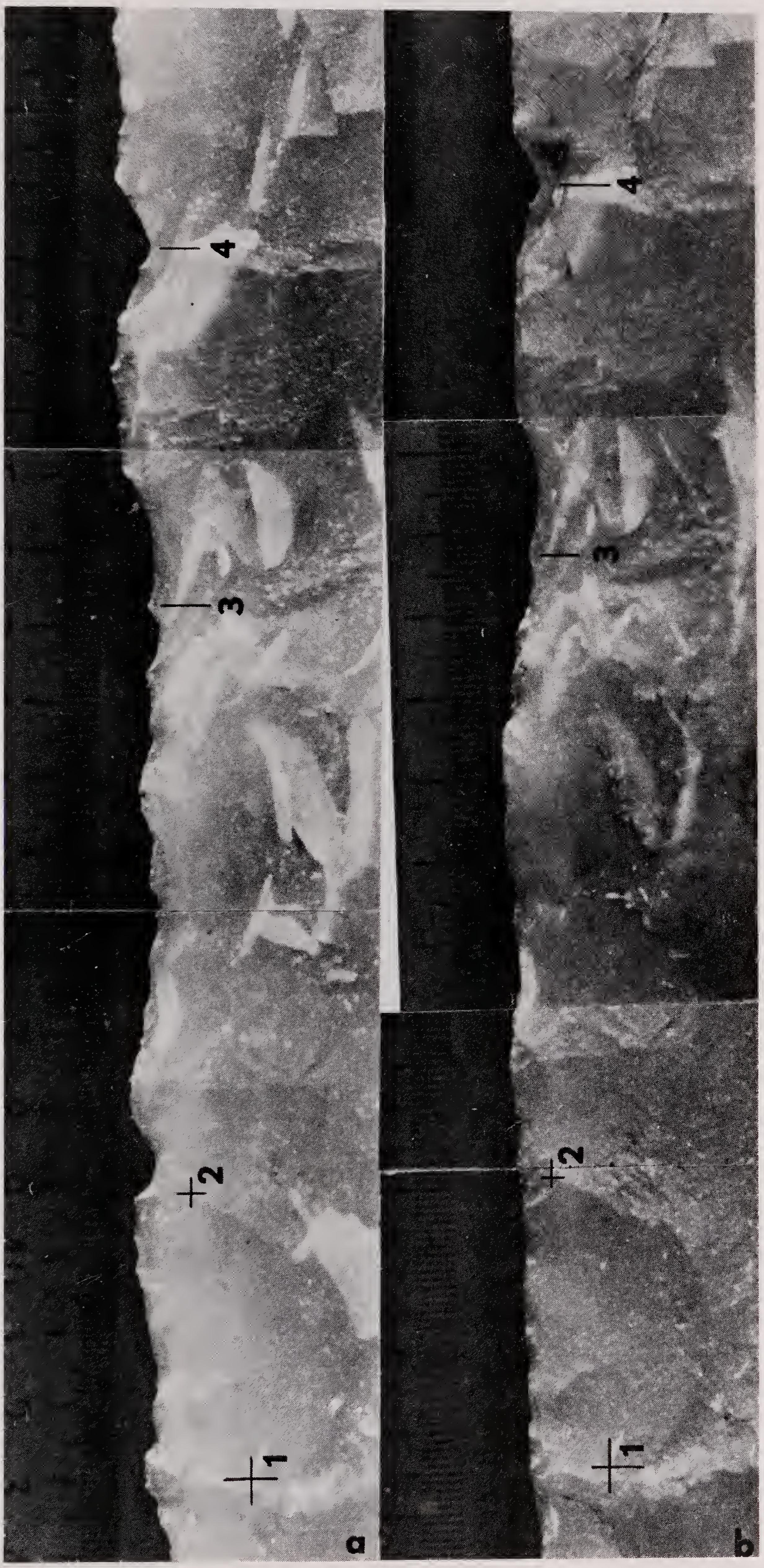


FIGURE 8.12. Before (a) and after (b) views of the working edge of the tool shown in Figure 8.11.

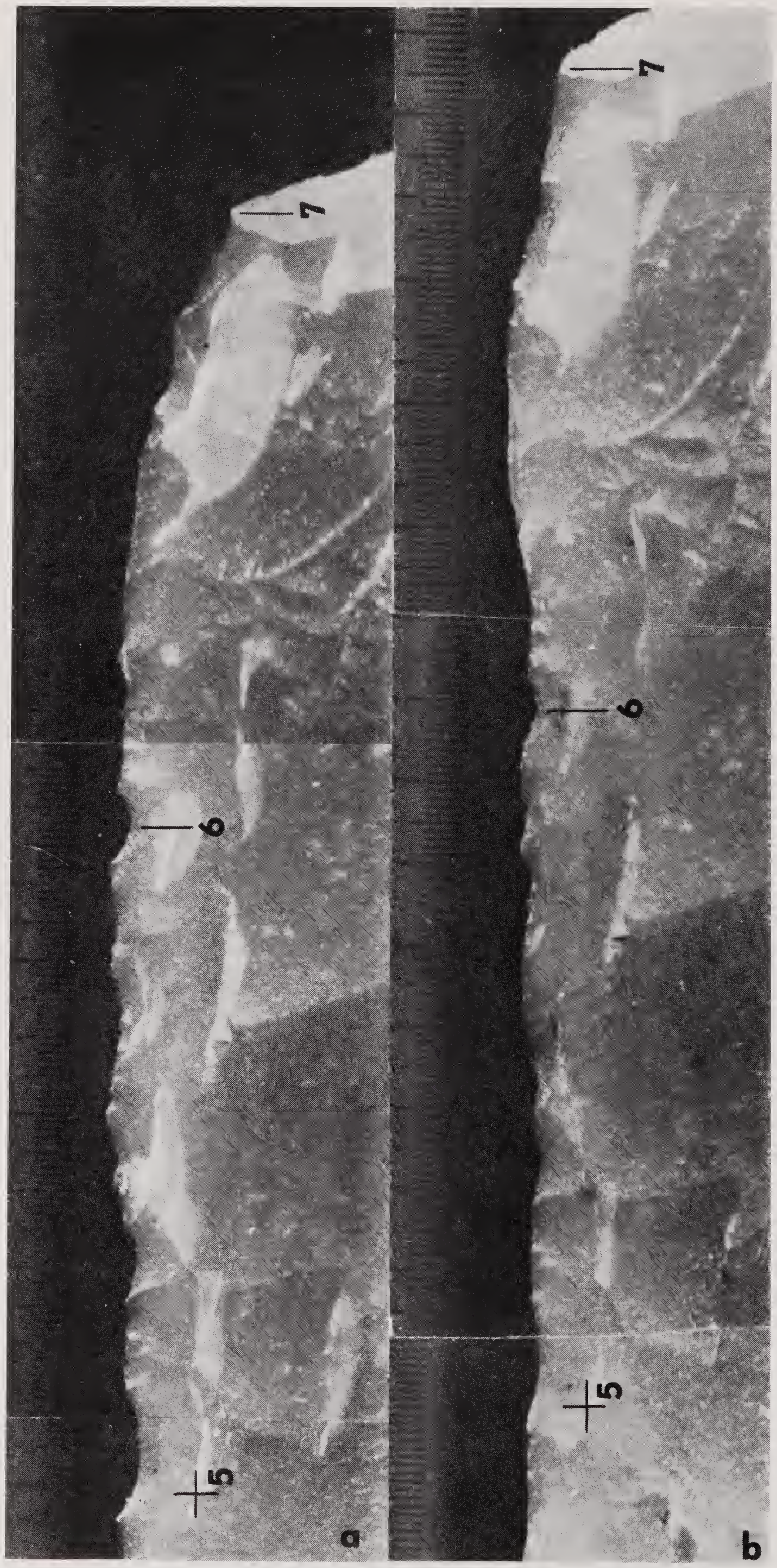


FIGURE 8.13. Before (a) and after (b) views of the working edge of the tool shown in Figure 8.11.

in the case of a bison just out of a mud or dirt wallow. Some actual figures are available. An excellent flake tool skinning knife of high quality chert (Figure 8.11) with 15.1 cm (5.94 inches) of cutting edge was used to cut 111.7 cm (44 inches) of hide on a 15-year-old female buffalo. This included the inside of one hind leg from about the midpoint of the metatarsal and a short section of hide on the belly. By the time this amount of hide was cut, the tool was too dull; further cutting of the hide required so much effort that the tool had to be sharpened. It was also well beyond the point where a butcher would normally have stopped and resharpened the tool. This does not mean that the tool would no longer cut hide. It means that it would no longer cut hide in the context of slitting the hide of a dead animal for purposes of skinning. When the hide is removed from the animal and hung or otherwise placed so it may be properly held, the same tool can be used to cut strips of hide equal to many times the length of hide cut while on the animal. In the initial opening up of the hide, the tool cannot be so manipulated and the butcher must depend on the keenness of its edge.

Although the tool was nonfunctional at this point for purposes of cutting the hide while on the animal, it was just right for skinning and also cutting flesh from bones. It was, however, nonfunctional for cutting ligaments or heavy muscles at or near points of origin or insertion. In other words, in heavy butchering a sharp stone tool will cut a small amount of hide or ligaments and will subsequently cut a lot of meat before it needs to be resharpened.

It may be of some value to demonstrate what actually happens to the working edge of a tool from the time that it is sharp and functional to the time it is dull and nonfunctional. The working edge of the tool in Figure 8.11 was photographed before and after use. A part of the edge is sufficient to demonstrate the effects of cutting a typical bison hide. The hair of the hide contains a normal complement of dirt, which affects the working edge of the tool. It can readily be seen that the sharp tool edge (Figure 8.12a and Figure 8.13a) is characterized by a number of sharp projections. Some resharpening of the edge occurs as parts of the working edge are broken off during use. However, the projections soon lose their sharp points and edges, and once they are worn smooth (Figure 8.12b and Figure 8.13b) the tool will no longer cut the hide.

One part of the tool edge was deliberately not used and here the condition before (Figure 8.14a) was identical to the condition after (Figure 8.14b). Unmodified flake edges were also used in skinning the same animal. In the test specimen, the working edge was relatively thin, forming an angle of from 10 to 14°. Using an edge this thin to cut heavy bison hide resulted in rapid attrition of the working edge, which had to be resharpened continually until the working edge was thick enough to resist breakage and the projections were worn smooth. No preference is felt for either tool edge type on the basis of actual use in bison butchering.

Some further thoughts on the use of projectile points in butchering can now be presented. A projectile point is designed to penetrate. The point and blade edges are sharp and cut a hole large enough for the haft to force the point into the animal far enough to cause a lethal wound. This kind of design does not make the optimum tool for most butchering processes. Projectile points are

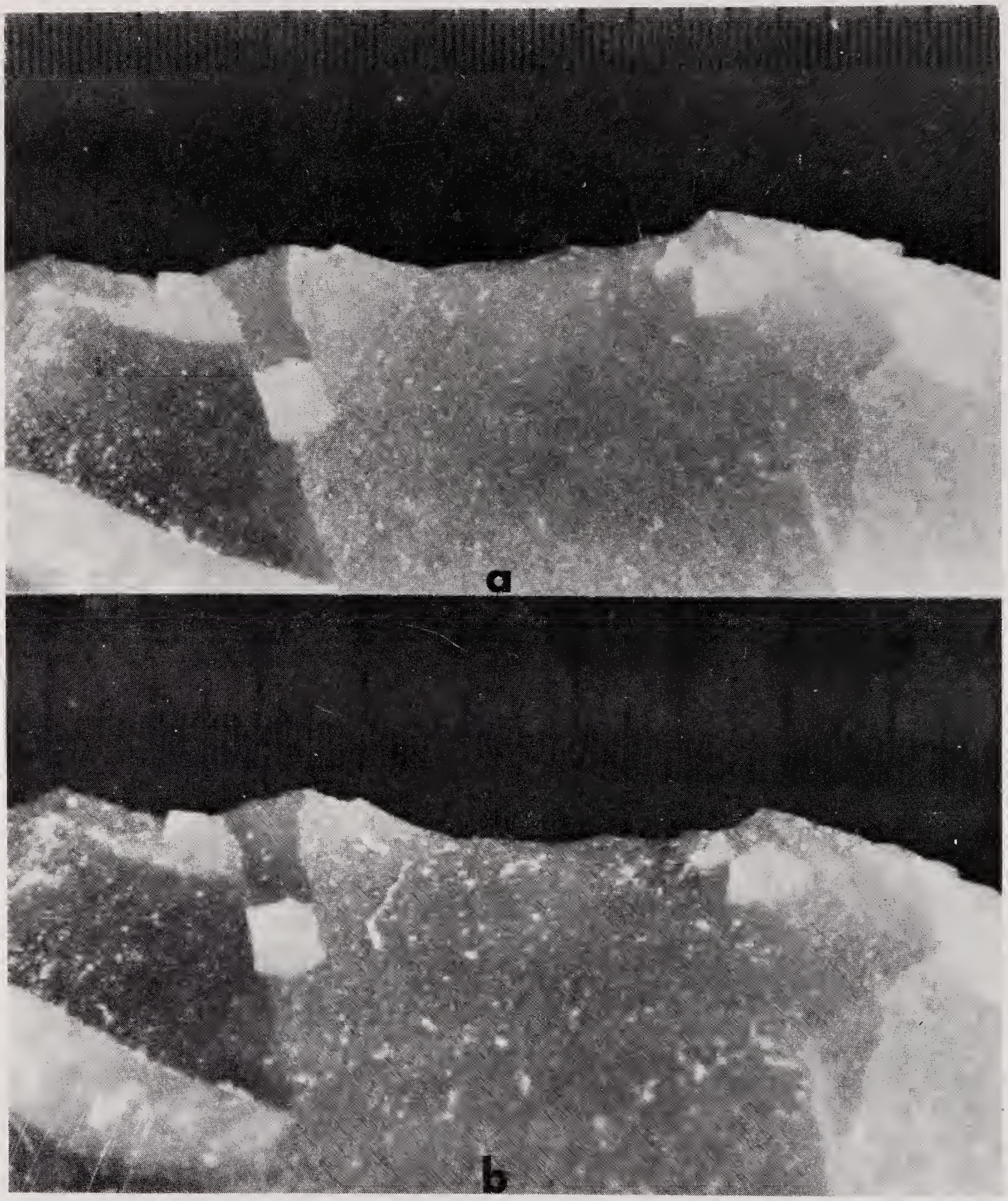


FIGURE 8.14. Before (a) and after (b) view of unused portion of the working edge of the tool in Figure 8.11.

particularly poor for cutting hide, since once the blade edges become dull they are difficult to sharpen to the right angle. Some large spears on a foreshaft have potential as skinning and flesh-cutting tools, but in most cases it seems to be great waste of effort to use one as a knife—unless it could no longer be used as a spear. In many Paleo-Indian bison kill sites, any section of a projectile point that could be reused as a projectile point was so treated—presumably because the thick, lenticular or diamond-shaped cross-section was a good penetrating device but not a good butchering device.

It is possible to haft some large spear points in such a way that they will perform some butchering tasks. Hell Gap points provide a good example since many of these are quite wide. One was hafted in such a way that it withstood hard use in skinning and cutting flesh (see Chapter 9, Figure 9.5a), but the foreshaft and the sinew binding were so heavy and bulky that it required an unusually heavy thrust to penetrate a buffalo properly. This design was discarded in favor of a foreshaft with smaller diameter and a lighter sinew binding that gave much better penetration (Figure 9.5b), but this would not stand the punishment of heavy butchering use. This kind of experimental evidence suggests that the more efficient the projectile point design becomes, the less efficient it is as a butchering tool. The opposite is also true.

Experimental butchering may help to clarify other tool-use problems. Fat buildup on tools has been presented as a limiting factor on the striations that may be transmitted to the wear surfaces of a tool and loss of function to a stone tool (Brose 1975). The experiments in this case are described as representing the ''total disarticulation of distal femur, patella and proximal tibia of a modern cow after the meat had been removed [p. 90],'' and ''ground covers were simulated by a cloth covered table, and a table covered with medium to fine sands [p. 90].'' These operations need to be discussed in an actual bison butchering context. First, disarticulation of the elements mentioned was apparently not one of the more important bison butchering processes. A stone or bone chopper was often used to loosen the patella from the trochlea. After this the remaining ligaments were cut while the tibia was bent as far as possible beyond the normal limits. The cutting was done with a flake tool. The trained butcher cuts ligaments only, whereas the untrained butcher allows the working edge of the tool to hit bone, which takes the keen edge off the tool so it will no longer cut ligaments and will need to be sharpened. Another way to accomplish the joint separation is to break the bones on either side of the femur–tibia articulation with a heavy hammerstone. In many cases, the joint was never separated at all. No butcher with any expertise would have allowed sand to get into the humerus–tibia joint area while butchering, regardless of ground cover, especially if the muscles were not yet stripped. This would unnecessarily impair the quality of the meat and no one, prehistoric or present, would give a second look to meat with sand in or on it. The ground cover would have no effect on the dulling of the tool, referring specifically to this one butchering process.

However, ground cover may have a profound effect on dulling a tool in the context of making the first cuts in the hide. Experiment will soon demonstrate that a dirty hide will dull a cutting tool faster than a clean one. Hide-cutting conditions may change rapidly if, for example, the animal was recently in a mud or dirt wallow or the corral or trap was muddy or the dead animal was trampled by others.

Fat can and does build up on a tool but the effectiveness of this on limiting the function of the tool needs more study. We were not able to perceive any limitation to the life of a tool used in butchering a bison even though extra fat was rubbed on the tool a number of times. The hide from the lower front foot of

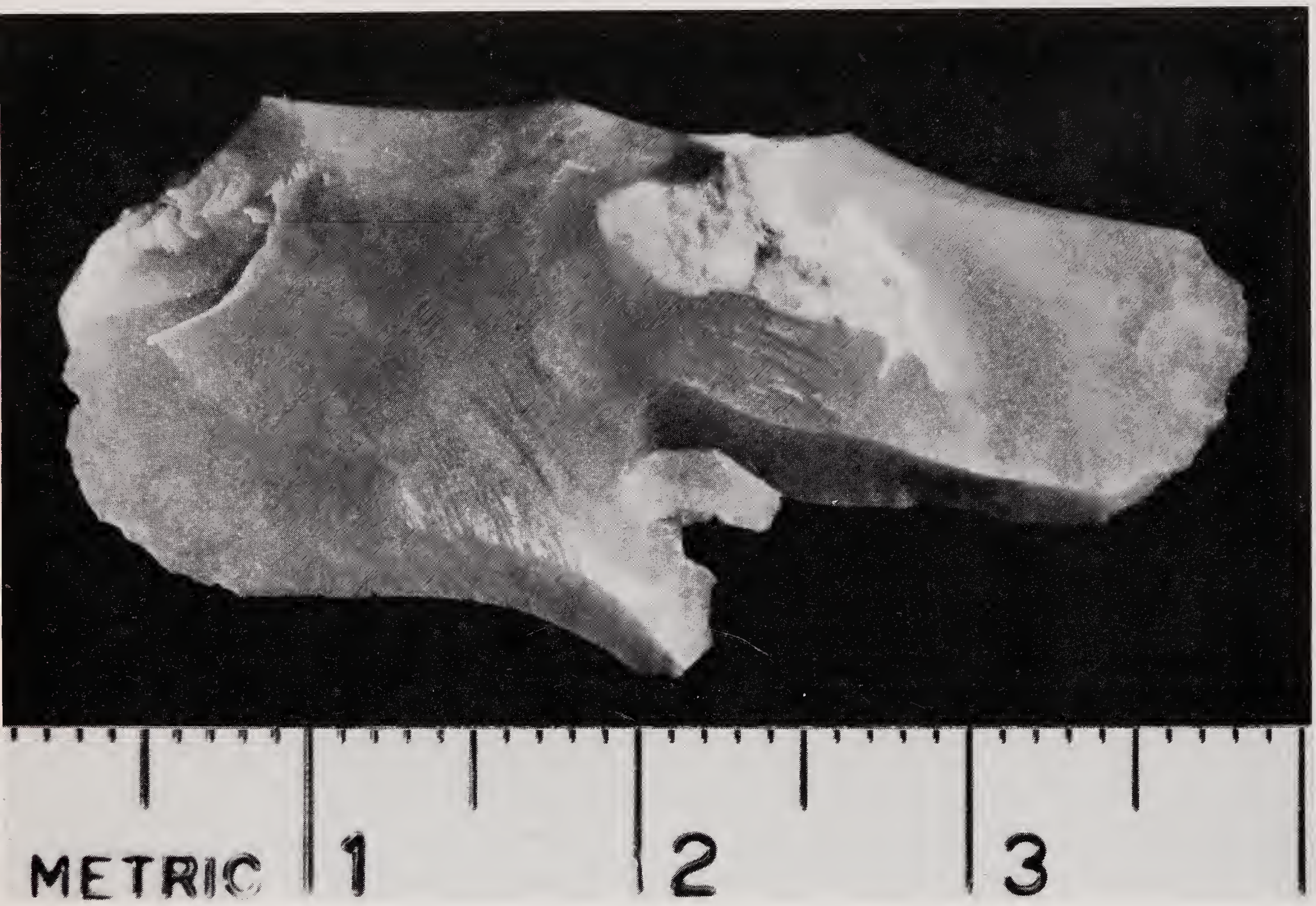


FIGURE 8.15. Flake tool used in experimental hide-cutting.

a buffalo (which is relatively thin compared to the hide on the back) was hung up and the flake shown in Figure 8.15 was used to cut the hide into narrow strips. The tool cut 300 cm (118 inches) of strips from the hide utilizing 32 mm (1.25 inches) of tool edge. After use the tool was dull but still (barely) functional. Continual application of fat had no effect on the function of the tool and it became dull no sooner than one without fat. No chemical or other tests were made for presence of fat on the tool edge, but the pressure of the tool against the hide apparently removed the fat.

It should also be added that in cutting strips of hide, the cuts were made from the flesh side, which eliminates the effects of dirt on the hide. The same flake tool was used without any modification to disarticulate the front leg at the distal radius–ulna and radial–medial–ulnar carpal joint completely to see if fat buildup had any effect on the function of the tool. It did not. The tool was then used to disarticulate the tibia–tibial–tarsal joint; still the fat buildup did not limit the function of the tool.

Time of use before the tool was dulled was another factor mentioned by Brose (1975), who found that 7 min was about the maximum length of time that tools could be used; although time varied for different stone types. The flake tool mentioned here (Figure 8.15) was used for 45 min of intensive use with no serious loss of function. Obviously the two bodies of data do not agree. Some possible reasons may be suggested.

Brose did not mention the condition of the animal represented in his experiment, so we do not know whether it was a feedlot or grass fat animal, whether it was in good or poor condition, and how long before butchering the animal had been killed, which would affect the condition of the fat. The flesh on a range bison is much different from that on a cow in a feedlot, which has fat marbled into the meat, an unnatural condition. A bison killed under natural grass conditions would have no fat marbled into its meat. An extremely important point not brought out in Brose's study is that bits of sinew and muscle common to the meat of undomesticated animals do tend to build up between the points on the uneven edge of a stone knife. These bits must be removed occasionally during use or the tool will not cut at all. Fat on a warm animal does not create the problems that it does on a cold animal. In the latter case fat can build up to the extent that it must be removed at regular intervals.

I am arguing here that experiments on butchering have to be placed in a total butchering context. If the butcher is cutting hide or ligaments, the process is altogether different than that used when the hide is first cut and the animal is ready to be skinned. Cutting flesh from bones is altogether different from cutting flesh into strips for drying, because the knife in the former situation continually makes contact with bone. Cutting flesh from bone also results in a continual accumulation of strings of sinew that soon cover the cutting edge entirely. Hide-cutting conditions can change rapidly if, for example, the hide is muddy or sand and dirt get into the hair as the animal is trampled in the bottom of a corral or trap. Fat can and does build up on a tool but how effective this buildup is in limiting the wear on a tool is not yet resolved. The fat on a bison is carried differently than on a cow. The fat behaves differently also on a tool used to butcher a hot, freshly killed animal than one that is cold, and most butchering is a warm-animal process. Hide and ligament cutting are the butchering activities in which sharp tools are most critical. The loss of function in skinning and cutting ligaments is due to the loss of the keenness on the stone tool edge—the same as with a metal knife. The relationship between fat buildup and the loss of function of stone tools needs to be explored further—but in the context of the butchering processes on the animals utilized.

Animal condition is another factor that affects butchering and also the meat products. The common figure of 400 lb of meat from a female buffalo refers to animals in prime condition in the late summer and early fall. At this time fat is in thick layers between the meat and ribs, brisket, and into the hump. The back fat may be an inch or more in thickness and present also in large strings and blobs in the intestines. The animal in poor condition presents an entirely different picture. The fat is no longer present on ribs, brisket, or back. The hump shrinks to practically nothing and the hide hangs tight to the animal and is difficult to remove. By actual weight, a buffalo cow in prime condition may have a hump with 30–40 lb of excellent meat, whereas an animal in poor condition such as is encountered in early spring after a hard winter may have a hump that weighs only 5–10 lb. A 15-year old buffalo cow killed in poor condition yielded only 225 lb of flesh in contrast to the one in good condition that yielded 348 lb. The difference in weight makes a good deal of difference in the contours of the animals and also affects the ease of manipulation of the animal during butchering.

I believe that the experimental butchering of bison along with a number of other animal species including antelope, deer, elk, sheep, and cattle has been instructive, and it has provided a background for a better understanding and appreciation of prehistoric butchering. On the other hand, it has by no means answered all our questions on the subject of butchering or tool use. Many more controlled experiments are needed that replicate actual past conditions as closely as possible. Butchering processes as observed in sites need also to be more closely analyzed and described. One approach along these lines was attempted by Brumley (1973). Continual site analysis combined with experimentation appears to be the best approach to interpreting past butchering methods.

9

Some Functional Aspects of the Weaponry of the Prehistoric Hunter

In a discussion of prehistoric hunters and hunting, we must consider the material items used in the hunting process—in terms of the actual procurement of raw materials, the manufacture of tools and weaponry, and the use of the finished products in the context of killing or wounding the animals hunted. In most contexts only the lithics remain, but occasionally lithics, antler, and bone remain. Wood and other plant remains are extremely rare, especially from the Paleo-Indian period, and interpretations concerning them must be based almost entirely on inference.

On the Northwestern Plains all known sources of stone flaking materials were exploited, though the sources were many and widely distributed. The procurement of raw materials was more than the mere gathering of available surface materials; it involved serious, well-planned, systematic efforts and the expenditure of great amounts of hard physical labor. In fact, the early settlers on the Northwestern Plains, who were deeply imbued with the Protestant ethic of hard work, were so impressed with some of the obvious aboriginal stone quarry sites that they immediately attributed them to the Spaniards. The rationale was that no aboriginal group could have expended this amount of energy; some European group had to be responsible. The Spanish Diggings in southeastern Wyoming, mentioned at an early date by Holmes (1919:210–213) is a good example. The amount of quartzite removed from the main quarries at the

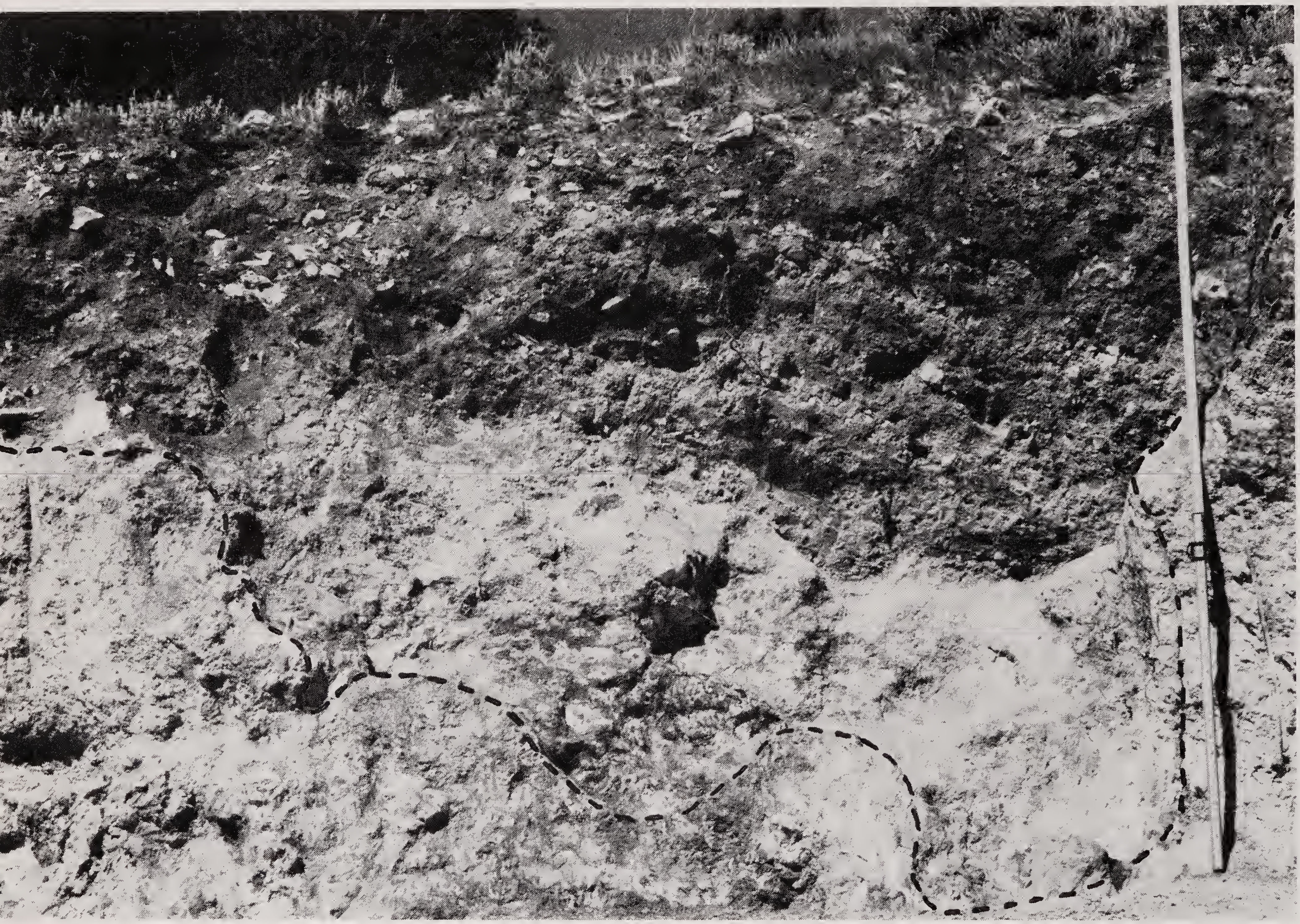


FIGURE 9.1. Aboriginal pit in a large stone quarry.

Spanish Diggings is phenomenal, to say the least. An examination of the reject material indicates that there was an effort to obtain a high-quality product with superior flaking qualities, since quantities of mediocre material were quarried and discarded. For several thousand years prehistoric man on the Northwestern Plains was willing to employ the most difficult mining techniques imaginable in an effort to gain access to superior stone flaking materials.

A less well-known example is a quarry site in the Bighorn Mountains of Wyoming known as Spanish Point. Several acres are pockmarked with pits up to 3 m deep (Figure 9.1) and trenches up to 2 m deep and 25 m long. The material sought was an exceptionally fine chert that occurred in nodular form dispersed throughout a somewhat softer matrix. Large numbers of hammerstones, along with bone and elk-antler digging tools (Figure 9.2), are common. Here also the name Spanish Point was the result of a belief that somehow the pits were dug by a group of wandering Spaniards searching for gold. Another large quarry site was discovered and systematically excavated near Three Forks in Montana (Davis 1973). The extent of the quarrying operations

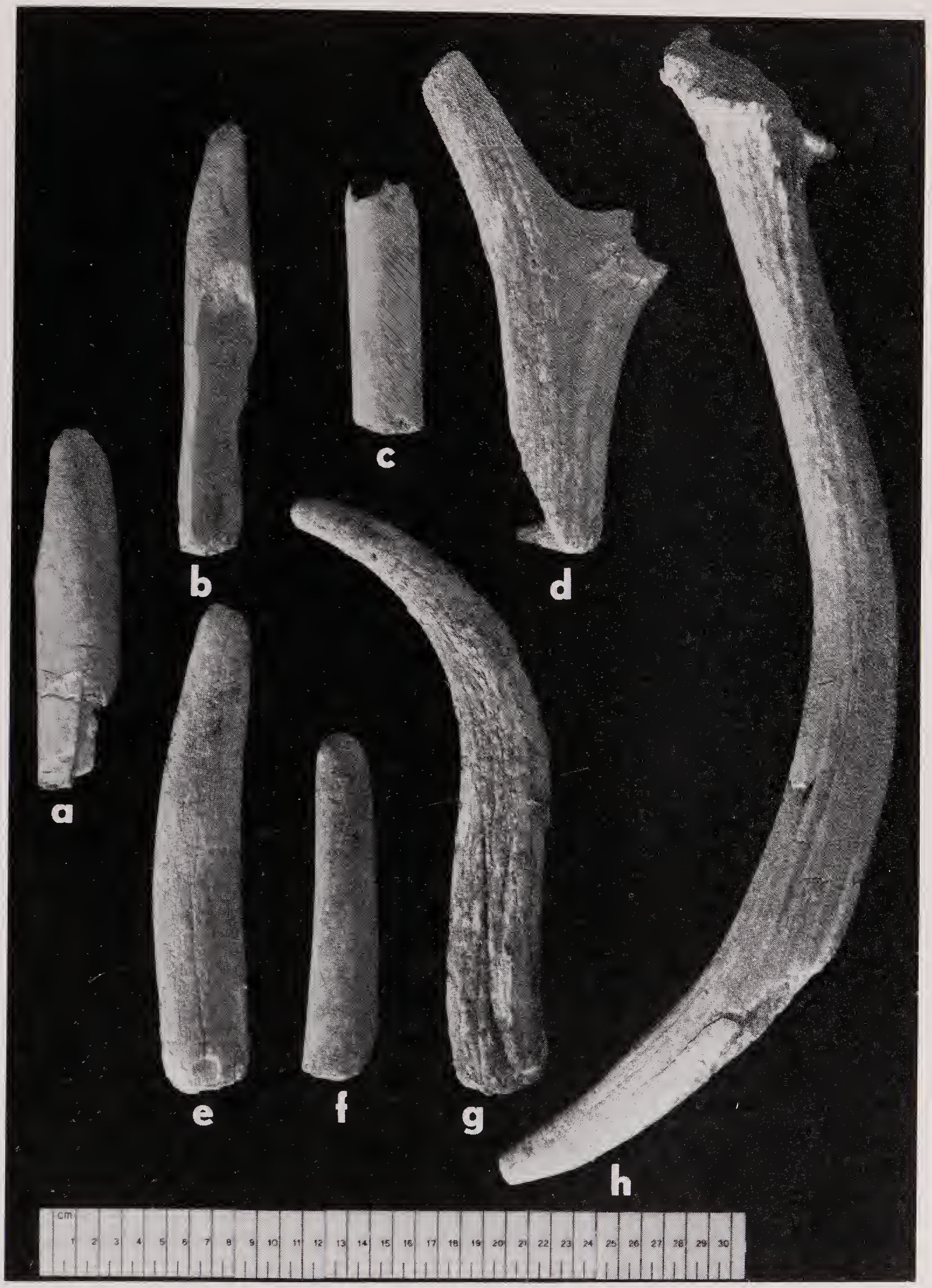


FIGURE 9.2. Elk antler (a, b, d–h) and bison rib (c) tools used to dig the matrix from the pit shown in Figure 9.1.

and the methods employed using bone and elk-antler tools in the mining process provide even more evidence of the high value placed on stone suitable for flaking. It was a vital and necessary commodity.

Lithic technology as a special area of study and research has proliferated, and a number of flint knappers with varying degrees of expertise have emerged in the process. The results of the work done in this field have added new dimensions to archeology in terms of cultural ideas involved with the procurement of and subsequent use of stone flaking materials. Lithic technology studies are beginning to provide valuable insights into cultural systems.

One of the aspects of lithic raw materials that very quickly becomes evident is that there is a relatively small amount of truly good material. This means that the flint knapper is forced to expend effort in direct proportion to the kind of material he is willing to work with. If he produces superior quality artifacts he or someone else is forced to expend great effort to provide a constant supply of superior raw material. A less demanding flint knapper might settle for less, but excellence in the finished product demands the best in raw materials. When the flint knapper finds or otherwise obtains superior raw material he also adopts an emotional attitude toward it. Few things are dearer to a flint knapper than a piece of raw material of superior quality and the best way to get a sample of an unusually good piece of material from a flint knapper is to have something of about equal quality to trade. It is not unreasonable to postulate that the aboriginal flint worker placed the same value on raw material.

A prehistoric communal bison kill is an example of a past situation in which a number of hunters prepared for a specific economic activity that had strong possibilities for failure. Hunters in this kind of situation do not ordinarily jeopardize their chances of success with inferior weaponry. No matter how skillfully the animals were herded into an arroyo trap, if the projectile points were not of the proper design to penetrate and kill the animals, the animals had a higher probability of escaping and the hunters a higher probability of going hungry.

However, when we analyze the projectile point assemblage in any known communal bison kill, whether Paleo-Indian or Late Prehistoric, we find a wide range of quality in the projectile points in terms of flaking technology. Not all of the excellence can be expressed as purely functional. Apparently the less aesthetic projectile points were every bit as lethal to a bison as the others—but the point to be made is this: The flint knapper usually put extra effort into good raw material, and when he did get a superior piece of raw material it appears that he tried to produce something of a superior nature.

Regardless of the aesthetic nature of the products resulting from the skill of the flint knapper and the quality of the raw material, there are functional aspects of weaponry used in hunting. This can be documented for a projectile point assemblage. However, for the Paleo-Indian materials at least, the perishable part of the assemblage must be inferred, at least until such archeological evidence appears which is possible but unlikely. Some inference may be possible from more recent materials where preservation is occasionally seen and this may be generalized to apply to older time periods.

From later contexts where perishable materials have been recovered, we know that the stone projectile point was somehow attached to the end of a wooden shaft. There are various technological solutions to this and most center around placing the projectile point in a notch or socket in one end of a wooden shaft and then binding it in place with sinew and some adhesive such as pitch.

Other possible methods include the use of bone foreshafts (see, for example, Lahren and Bonnichsen 1974) but the context here concerns bison kills, in which no bone foreshafts have been recovered. However, the hafting process is not all that simple. In order for the average Paleo-Indian or any known stone projectile point to be effective on large animals, it must penetrate a distance more than the length of the point itself. The tip of the point must first penetrate, and then the blade edges must cut a hole large enough to allow the shaft and hafting elements to follow through far enough into the animal to reach vital spots. If the shaft and binding are too large, it is nearly impossible to drive this bulge through the hole formed by the projectile point. The binding must be secure enough to prevent movement of the projectile point in the haft, but it must not be so bulky as to hinder penetration.

We do not know whether the Paleo-Indian projectile point was mounted on a foreshaft or mounted at the end of a single shaft, but the argument for the use of the foreshaft is strong. The technological solutions for manufacturing an easily changeable, reliable bond between a mainshaft and a foreshaft are relatively simple, although manufacture would be time-consuming. The advantages are many. It is relatively easy to carry several foreshafts and a single mainshaft; a person using a thrusting spear can spear a large animal such as a bison and pull off the mainshaft, leaving the foreshaft in the animal. He can then insert another foreshaft, or he can use the mainshaft for protection if he is killing animals in a corral or trap. Maintenance is easy since the foreshafts are carried separately and are not as readily subject to dulling or breakage. Portability alone is a sufficient argument for the preference for detachable foreshafts over a number of long shafts.

We also do not know whether a socket or a split shaft was preferred. The case for a socket for a typical Hell Gap projectile has been presented (Frison 1974b). The same argument would hold for some similar projectile point types such as Agate Basin points. It can be demonstrated, however, that a split shaft is also functional for a projectile point with a tapered tang or stem.

Three projectile points were used experimentally on two grown Hereford cows and a yearling. The foreshafts were attached to a lodgepole pine shaft 330 cm (130 inches) long, 42 mm (1⅝ inches) in diameter at the large end, and 22 mm (⅞ inches) in diameter at the small end. Penetration of the rib cage was relatively easy; over 20 cm (8 inches) of the typical Hell Gap point and foreshaft went inside the rib cage. Entry was between two ribs. The next thrust was not effective since the projectile point hit a rib squarely and penetrated the cancellous part of the rib, breaking the point in two places, destroying the sinew binding, and breaking part of both ends of the notch in the wooden foreshaft (Figure 9.3). These results closely parallel those observed in bison kill sites with regard to this projectile point.

The other two foreshafts contained typical Agate Basin projectile points (Figure 9.4) and performed successfully as spears. Subsequent attempts to slit the hide and perform other butchering operations on the animals using these as tools were not successful, since the sinew bindings were not strong enough to

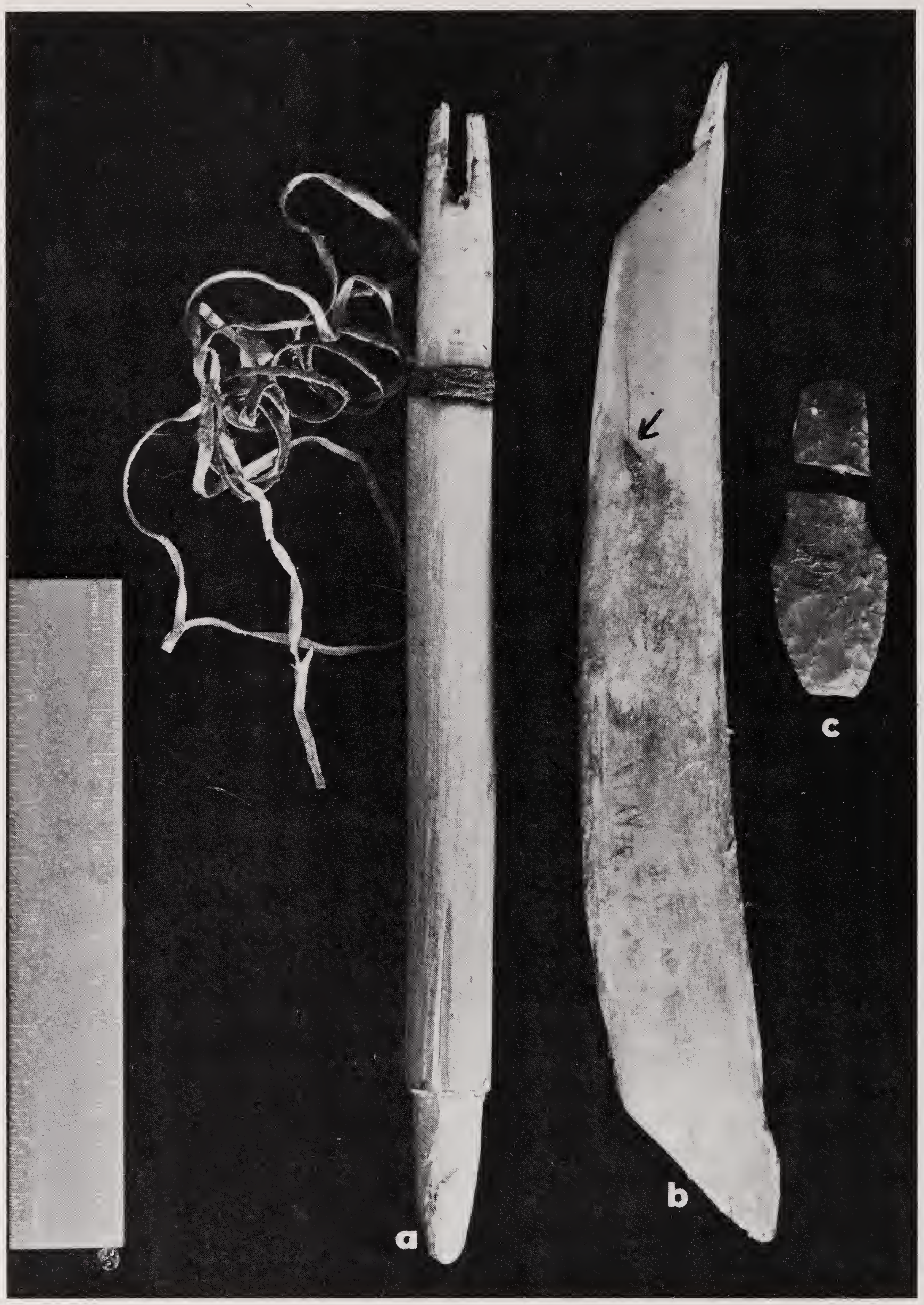


FIGURE 9.3. Experimental projectile point (c) and foreshaft (a) used with a thrusting spear. The point broke when it penetrated the rib of a cow (b).

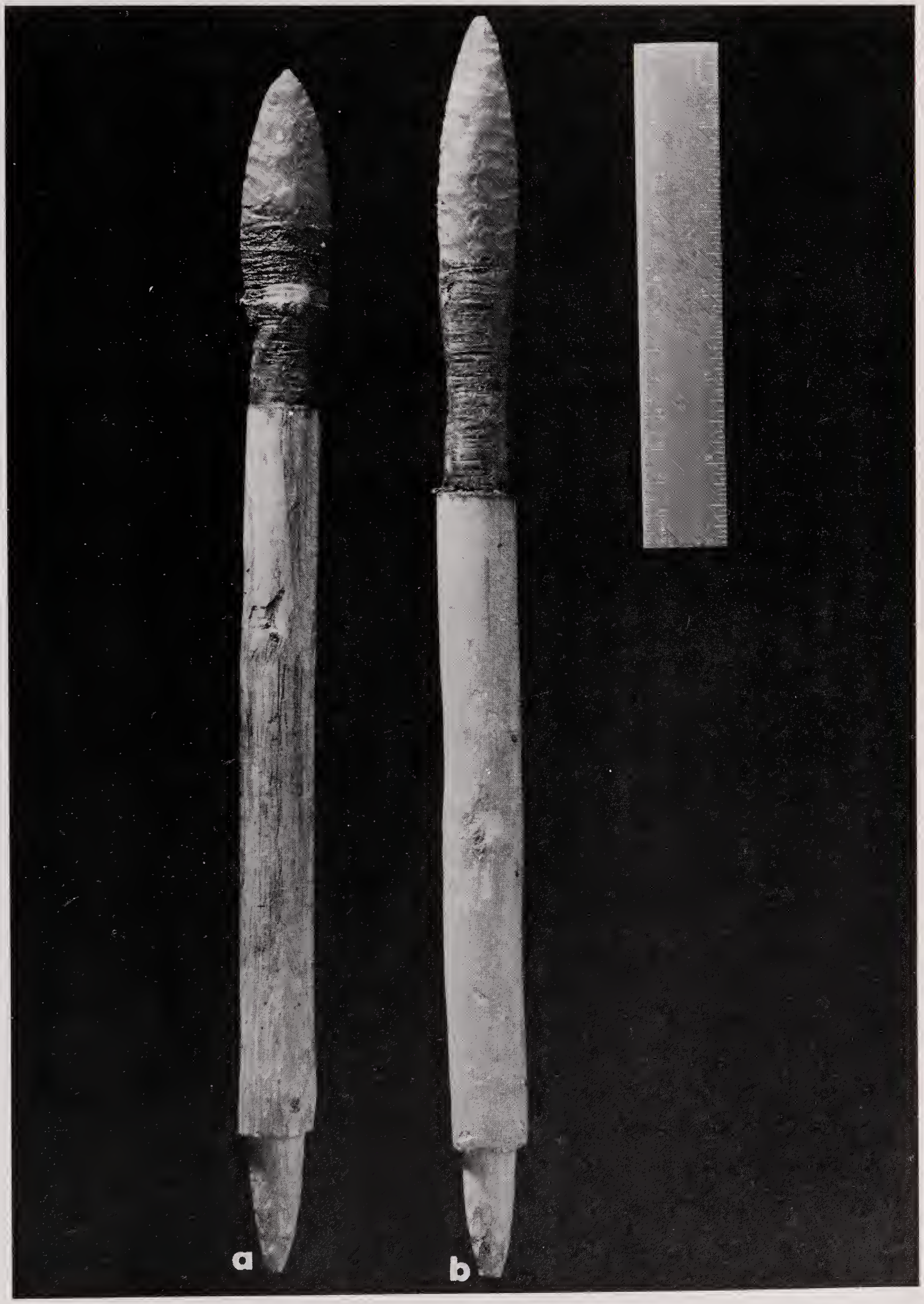


FIGURE 9.4. Experimental projectile points and foreshafts used with a thrusting spear.

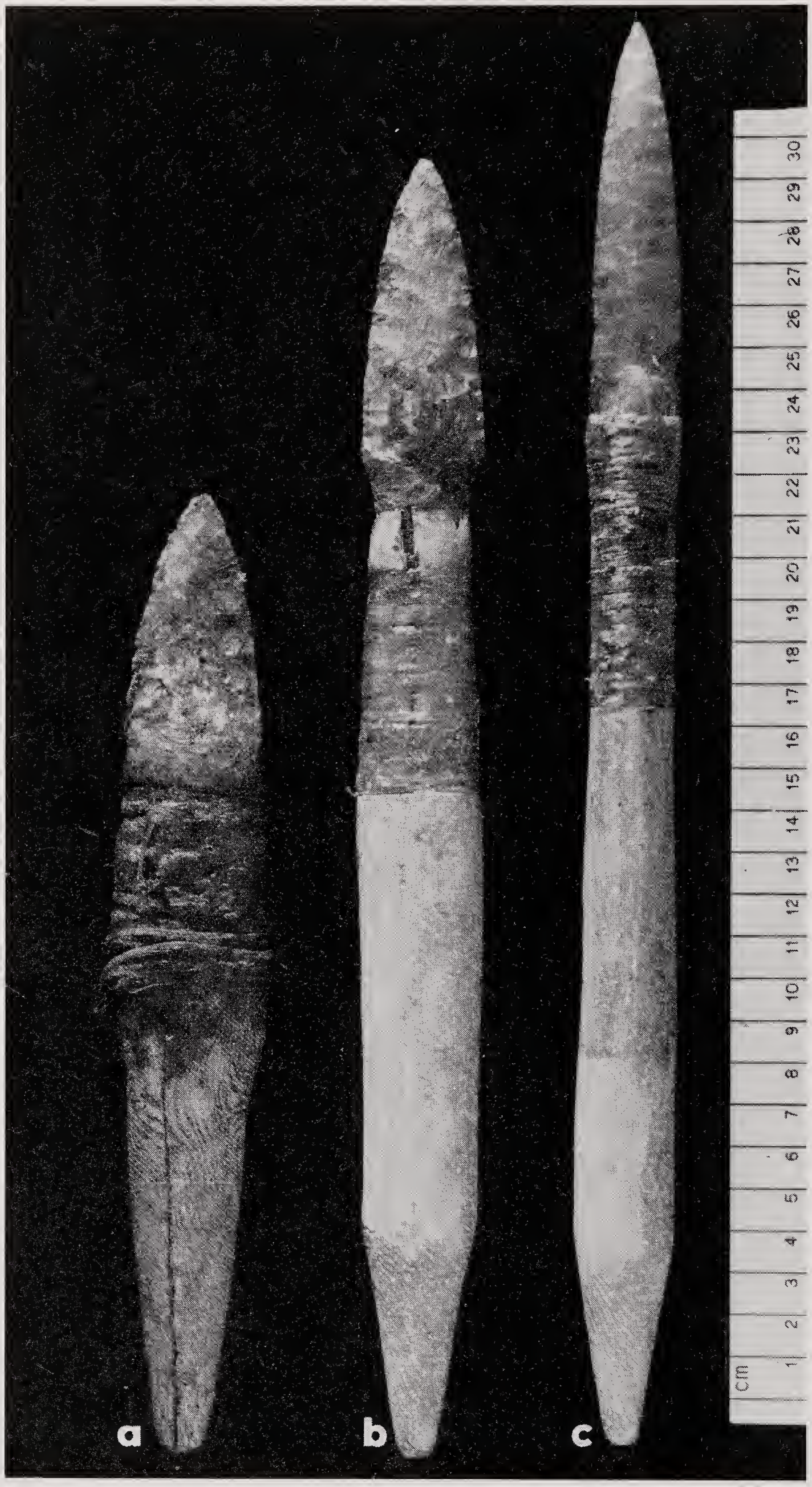


FIGURE 9.5. Experimental projectile points and foreshafts used with a thrusting spear.

withstand the pressures encountered under intensive use for more than a few moments. Also, the projectile point was far from the optimum tool for butchering, although the problem of a larger, stronger haft and a heavier binding could be easily solved. In doing so, however, its function as a projectile point would be impaired because the amount of binding and the larger shaft needed would make effective penetration into a lethal spot more difficult.

We may never know the exact method of hafting Paleo-Indian projectile points for functional use, although hypothetical reconstructions will always be attempted (Frison 1974b; Lahren and Bonnichsen 1974; see Figures 9.4 and 9.5). However, some information may be obtained from later time periods. Foreshafts designed for use with throwing sticks and long mainshafts recovered from dry caves embody all the principles mentioned as essential for the hunter to take into account (see, for example, Chapter 2, Figure 2.11; see also Frison 1962, 1965). The projectile point tip is extremely sharp, as are the blade edges; the hafting elements are designed to absorb the necessary thrust for deep penetration; and the foreshaft is designed to fit into a hole in the mainshaft in such a manner that it is secure and perfectly straight, so the force exerted by the mainshaft will drive the projectile point and foreshaft deep into the animal without sideways pressure that would cause breakage. In addition, the design of the mainshaft is such that the foreshaft will not split it on impact.

Another series of foreshafts with projectile points was tried on bison. One was a wide Hell Gap projectile point mounted in a heavy wooden socket (Figure 9.5a); another was a slightly narrower Hell Gap point mounted in a wooden socket (Figure 9.5b), and the last was an Eden point mounted in a split foreshaft (Figure 9.5c). All were bound with buffalo sinew and pitch.

The first specimen was only marginally functional. The wooden socket and binding were so bulky that the projectile point was not able to cut a large enough hole to allow easy entry of the foreshaft. However, the design was of sufficient strength to make a functional cutting tool that would withstand heavy butchering, although attrition of the projectile point blade edges was high.

The smaller Hell Gap point was first mounted on a larger foreshaft, but the bulge formed by the end of the wooden socket and sinew binding was still too large for easy entry of the projectile point. Reduction of the bulge resulted in the present form (Figure 9.5b), a design that easily penetrated the rib cage of a bison with only the loss of the sharp tip of the point. The function of the weapon can be easily restored by reshaping the point. The tip was broken by contact with a bison rib. Unlike the rib of a cow, the bison rib is rounded and usually deflects the point into the rib cage although some breakage is common.

The third specimen, the Eden point (Figure 9.5c), was mounted on a foreshaft of relatively small diameter with the aid of a light sinew and pitch binding. The design proved excellent for spearing bison and would probably function well also with a properly designed throwing stick and mainshaft. It was used with the same 330-cm-long spear shaft described previously, and the full length (29 cm, 11.5 inches) penetrated the rib cage of a mature female buffalo with relative ease, but once again with minor damage to the sharp point. The larger diameter of the spear shaft limited the amount of penetration, or the foreshaft would probably have gone on through the animal and penetrated the opposite side. This is the optimum design to date for killing bison using a thrusting spear. Whether it represents the actual past design we may never know.

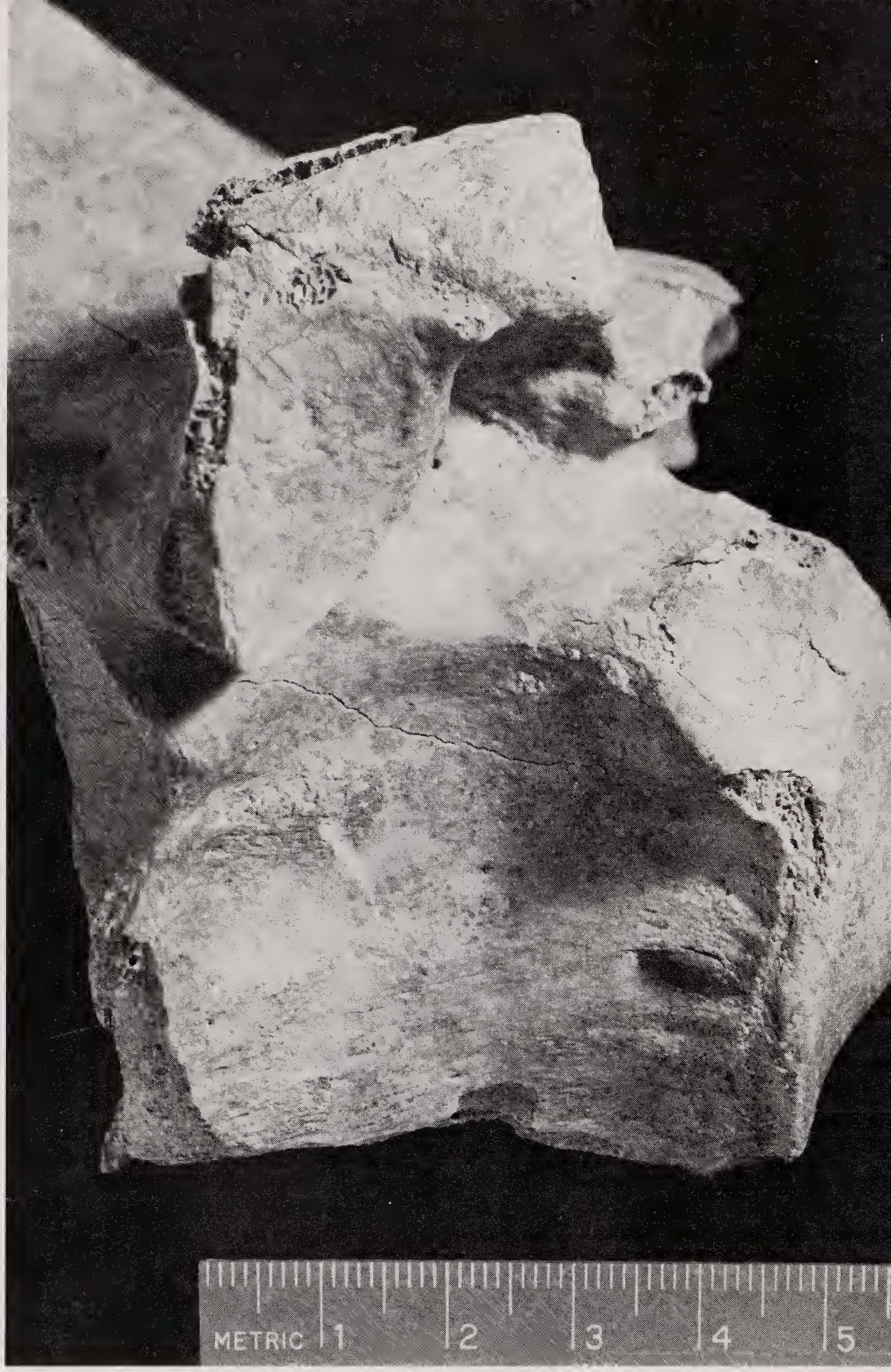
Projectile point design was of vital concern to the hunter. An analysis of projectile points from bison kill sites from over 10,000 years ago to the beginning of the historic period will bear this out. The attributes necessary for the proper functioning of a projectile point as a device to kill a large animal such as a bison are these: sharp point to penetrate the hide, sharp distal blade edges to open a hole for the remainder of the point and shaft, and a hafting element designed to absorb the thrust without splitting the shaft. It is no accident that projectile points in bison kill sites have extremely sharp points; the tip is often elongated (see Chapter 5, Figure 5.40e, f). If the tip is dull, the point is usually crushed and either does not penetrate or penetrates insufficiently to kill the animal. Such sharp points are not easily maintained, and it is easy to visualize the prehistoric hunter applying a sharp point to his projectile points as a last act just before use. He may also have had covers to protect them. Nothing is more frustrating to a hunter than to have a lengthy process of stalking or driving game come to naught because of equipment failure.

In order for weaponry of this nature to be effective on large animals such as bison a number of basic rules need to be observed by the user. The stone projectile point should make contact at nearly a right angle to the part of the animal it is to penetrate. Contact at the wrong angle will cause the hide to bunch up, creating a mass impossible to penetrate. Penetration of any consequence in rib cage or stomach cavity will eventually cause the animal to die, although a wound in the stomach cavity will usually take longer than one reaching the heart or lungs. The spinal area is also a vital area, but unless the hunter has the animal under good enough control and can place the projectile carefully enough, it is better to rely on the rib cage because it is a bigger target and the chances of success greater. Animal size also has to be considered. A large male has heavy hide and more muscles along the back, whereas a female or younger animal is smaller and has less hide. However a projectile point may be driven through a good deal of hide and muscle and still have quite a bit of penetrating force left (see Figure 9.6). Flesh wounds can be serious and eventually cause an animal to become sick enough to go down. On the other hand, an animal with a serious flesh wound can travel a long distance if it is frightened or is not given a chance to lie down. The same is also true of a stomach wound. The wise hunter allows the wounded animal to lie down for as long a period of time as is needed for the effects of the wound to impair the animal's normal reflexes. If the wound is serious enough, the animal may not be able to get to its feet at all. On the other hand, that same frightened, seriously wounded animal on its feet may travel for several miles. Approaching close enough to get in a lethal shot is easier if the wounded animal is allowed to lie down for a while.

The size and sex of the animal are determining factors. It is relatively easy to place a projectile in the throat of a young female bison or a calf and the results are extremely effective. This occurred many times in bison traps and can be documented (see Chapter 5, Figure 5.34). The same method might not be as effective on a mature male because of his thicker hide. The rib cage was a favorite target and this can also be documented (Figure 5.35). Several things might affect the choice of projectile placement besides size and sex—whether the animal is standing still or moving; what part presents itself unobscured; and what the chances are of the animal's immediate escape.

The experienced hunter usually avoids any desperation try for an animal. For the hunter to fling a spear, a dart, or an arrow at a bison running at full

FIGURE 9.6. Penetration of projectile point into thoracic vertebra of a bison.



speed away from him is futile because he has little chance of hitting a vital spot. On the other hand, the experienced hunter can usually call the results of his shot. For example, the immediate involuntary reaction of an animal after being hit with dart, spear or bullet tells the hunter whether penetration is deep or shallow and whether he has made a heart, lung, intestinal, or flesh shot. From this the hunter knows whether the animal needs further attention. If the hunter is confident that the animal has taken a lethal wound, he can wait for it to die; if he wishes, his attention can then be directed toward another animal in the herd. He knows he already has one kill even if the animal is not yet dead or is nowhere in sight.

As mentioned in the context of the Agate Basin site, the thrusting spear in terms of prehistoric bison hunting was a confrontation weapon. Usually the first action of a range bison in open country upon seeing a man is to get away from him. However various means may be used to get close to bison, as the experiments of McHugh (1972) in donning a buffalo hide and mingling with the Yellowstone Park herd demonstrate. The thrusting spear obviously requires proximity to the animals. The problem is that once the hunter does get close to the animal, he has to be exceptionally quick in thrusting the spear or the bison will move out of range immediately. The weapon is not very effective on an animal running away.

The trap or corral is the ideal situation for the thrusting spear as a confrontation weapon. The mature animal sees the hunter and tries to escape; when it realizes escape is impossible it will usually do an about-face, possibly charge the hunter, try to climb out of the trap, charge into the other animals, or attempt other similar behavior. During this time the animal is extremely vulnerable to a properly thrust spear. Also, the spear shaft offers a certain amount of protection to the hunter. Killing young animals presents little problem once the older ones are down.

Some experiments have been made on cattle using a spearthrower and dart. The results have been surprisingly good in terms of projectile point penetration. It is quite likely that most hunters would hesitate to crawl into a corral or trap that contained a number of bison because the hunters would undoubtedly be in danger of being charged by some of the animals. Actually, entering a corral that contains a single bison might be more dangerous than entering a corral containing a number of the animals. A single animal in this situation is often more unpredictable than a group. A more prudent approach would be to throw a spear or dart from atop the walls of the trap or from outside the corral.

Every hunter with experience is also aware of the futility of "bunch shooting." Many animals and birds are gregarious and when frightened they tend to stay in a tight group. Quite a few hunters, in the immediate excitement of seeing a large herd of game, lose control and simply fire into the densely packed animals. They are seldom successful. The only course of action that brings any substantial rewards is for the hunter to decide quickly what animal in the group he wants and direct his full attention to a lethal spot on that animal. He can turn his attention to another animal after the first one is secured. Bunch shooting results in crippled animals but relatively few dead ones.

Individual hunting can be efficiently done and extremely rewarding to the hunter, and the amount and kinds of animals taken can be highly predictable. On the other hand, two or more experienced hunters operating together will experience greater success. The key to successful hunting is to locate the animals before they locate the hunter. With two or more persons cooperating, one can remain hidden while the other or others can move the animals, who are concerned only with the persons they are aware of. This works well with animals that hide in rough, brushy country and is about equally successful with animals like pronghorn that normally live in open, flat country.

Many hunters of today would probably argue that improved weaponry has been the greatest aid to the hunter. I would argue that an aid of equal importance to hunting has been optics. Field glasses greatly increase the hunter's chances of locating the animal before the animal can see the hunter. Once spotted, the animal can usually be approached closely enough to be killed easily.

This leads to considerations of familiarity with the hunting area. No hunter feels comfortable in unfamiliar territory; he has to learn the topography and the way that the animals behave within it. Weather, time of day, time of year, herd composition, and terrain are only a few of the major factors that affect the behavior of the herd. A good hunter can go into unfamiliar territory, make quick judgments, and have some success, but it is often the subtle things about a given hunting *area* that are of great importance. The animals themselves know the area. They know where the best cover is. The hunter has to know what lies over the next rise in order to predict what the animals on this side of the rise will do. In other words, absolute familiarity with a hunting area is of prime importance to success.

The strategy of the prehistoric hunting operation—except for the large communal procurement operation—whose purpose was to alleviate hunger on a continuing basis was to take animals regularly and disturb the remainder of the animals as little as possible. The better the hunter, the less evidence there is of his activities in the actual hunting area. Hunting as it exists today bears little resemblance to the prehistoric situation in terms of purpose of technology. Many species of animals hunted in prehistoric times are still extant but some have been forced into different behavior patterns because of changes or loss of habitat. Even so, a good deal can be learned by an experimental approach to prehistoric hunting.

10

Hunting and Gathering Subsistence Strategies

Throughout this book I have continually stressed the importance of prehistoric hunting on the Plains. However, gathering must not be ignored; it was a significant part of the economic process. One way to discuss the subject of gathering on the Northwestern Plains is to consider several questions that focus directly on the problem and can only be answered in part considering the present body of archeological and ethnological data.

1. Where can the division between hunting and gathering be made? Hunting is usually confined to procurement of larger game animals with the use of various weapons and sometimes with the assistance of some means of containment, either natural or artificial or a combination of both. Some of the ways in which rabbits were taken might be regarded as hunting, whereas some traps, snares, or deadfalls might be regarded as something other than hunting. Wood rats, apparently a food item of some importance in certain past contexts, required a good deal of skill to be taken in snares; still, this can hardly be classified as hunting. Porcupines, another common prehistoric food item, can be taken at any time with a stick or a rock.

2. Were the game animals present in sufficient quantity year-round to provide a sufficient food base? This was a variable that undoubtedly changed periodically as climatic changes occurred. As populations of the larger game animals went through periods of decline, the human groups undoubtedly

shifted their economic orientations toward a more varied diet. Very likely, the ideology that the bison provided everything expressed by the historic Plains Indian buffalo hunters has crept into and dominated our thinking about prehistoric economic systems on the Plains. In reality, these hunters would not have been able to survive if gathered food products had been subtracted from their economy.

3. Is the hunting concept an expression of an ideology that was concerned as much with prestige as with provisioning the group? The implements of the Plains hunters, the projectile points, appear in many cases to have been made with more than functional utility in mind. Rewards accrued to the good hunter but whether more for provisioning the group or for maintaining an ideology is not always clear. Neither is it clear whether the ideology of the hunter was dominant enough to bring forth expressions of contempt for gathered food. A material culture item of the historic Plains Indians was the berry pounder, and although the various products of the buffalo were the most highly regarded, seasonal harvests of berries, fruits, roots, tubers, and other plant foods are often mentioned as part of the yearly economic cycle. On the other hand, relatively impoverished, lower-status Shoshonean group was called Sheepeaters. In reality, mountain sheep procurement requires about as much true hunting ability as the procurement of any game animal. A more appropriate title, if contempt was intended, would seem to be one associated with a less prestigious animal.

4. What is there in the archeological evidence that can be used as indicators of gathering and the use of plant foods? Both procurement and preparation of plant foods differed from those of animal products and should be reflected in tool assemblages and site features. It is generally agreed that grinding slabs with pecked surfaces used in conjunction with a mano stone reflect breaking the hard outer shell of various seeds, a process necessary for human consumption. They might also have had some use in breaking and grinding bones of small animals.

Features commonly classified as roasting pits are thought to reflect preparation of plant foods, although some small-animal bones often appear in them. These tools and features seem to have a time depth of nearly 10,000 years on the Northwestern Plains, and their use increased during approximately the last 4500 years. Perhaps the immediate future will witness the development of a better methodology for interpreting the actual use of these kinds of archeological manifestations. The use of many plant foods could have left nothing in the archeological record, except in rare circumstances. Most fruits, berries, and tubers fall into this category, as their procurement and use required nothing in the way of imperishable tool assemblages or specialized site features.

5. Can animal population studies become sophisticated enough to determine the seasonality of animal procurement accurately? This might aid in telling us if hunting was deemphasized during certain times of the year. Archeological interpretations on the Northwestern Plains rely heavily on faunal analysis. Bones and teeth preserve well compared to floral remains. Seasonal aspects of animal procurement should be interpretable from faunal remains

provided valid samples are recovered and adequate age determinations are possible. Methodologies for reliably determining the age of animals are in the development stages but demonstrate good promise.

6. Was food storage necessary for the survival of historic human groups on the Northwestern Plains? It is difficult if not impossible to conceive of the continued survival of prehistoric cultural groups on the Northwestern Plains without some means of short-term food storage. Winters were long and difficult, and even though a certain amount of food procurement activity occurred during winter, there were times during any given winter when the food quest was not possible. The difficulties encountered by prehistoric cultural groups in seeking food during extended periods of subzero weather are not easy for us to conceive. Frostbite could be serious and could effectively reduce a person's ability to provide food for some time. Just providing warm, livable quarters during this kind of weather must have greatly taxed the capabilities of prehistoric men and women. To engage in food procurement activities on the Plains in extremely severe winter weather would have necessitated a level of sophistication similar to that of the Eskimo, and there is no evidence of such sophistication.

A relatively small amount of stored food, either animal or vegetable or both, would have been the key to survival during such adverse weather conditions. Meat is ideal for storage because its weight can be reduced about 10 times by drying, and if kept dry it can be stored for several months. It is also a highly concentrated form of food. About ½ lb per day provides adequate rations for an adult. The flesh from 2 full-grown adult bison or 20 antelope would dry into about 100 lb. This quantity has the potential to sustain a family group of six persons for about a month, which would tide the family over critical times during most winters. However, winter intensities were not predictable from year to year, so greater amounts of stored food were needed to allow for winters similar to the one of 1886, which was disastrous to wild and domestic animals and created great hardships for human groups. Plant products, such as grass seed, are a highly concentrated food that could also have been stored. However, a strong possibility exists that the true function of communal animal kills provided products for storage.

Exploring these and other ideas and equating them with the archeological and ethnological evidence make it difficult to accept that prehistorically there were cultural mandates that opposed food gathering as part of the economic process. On the contrary, it appears that gathering was an integral part of the economy and that it was important to the survival of the cultural groups involved.

THE BIGHORN BASIN

I have selected the Bighorn Basin as the setting for a discussion of hunting and gathering subsistence strategies because intense investigations have

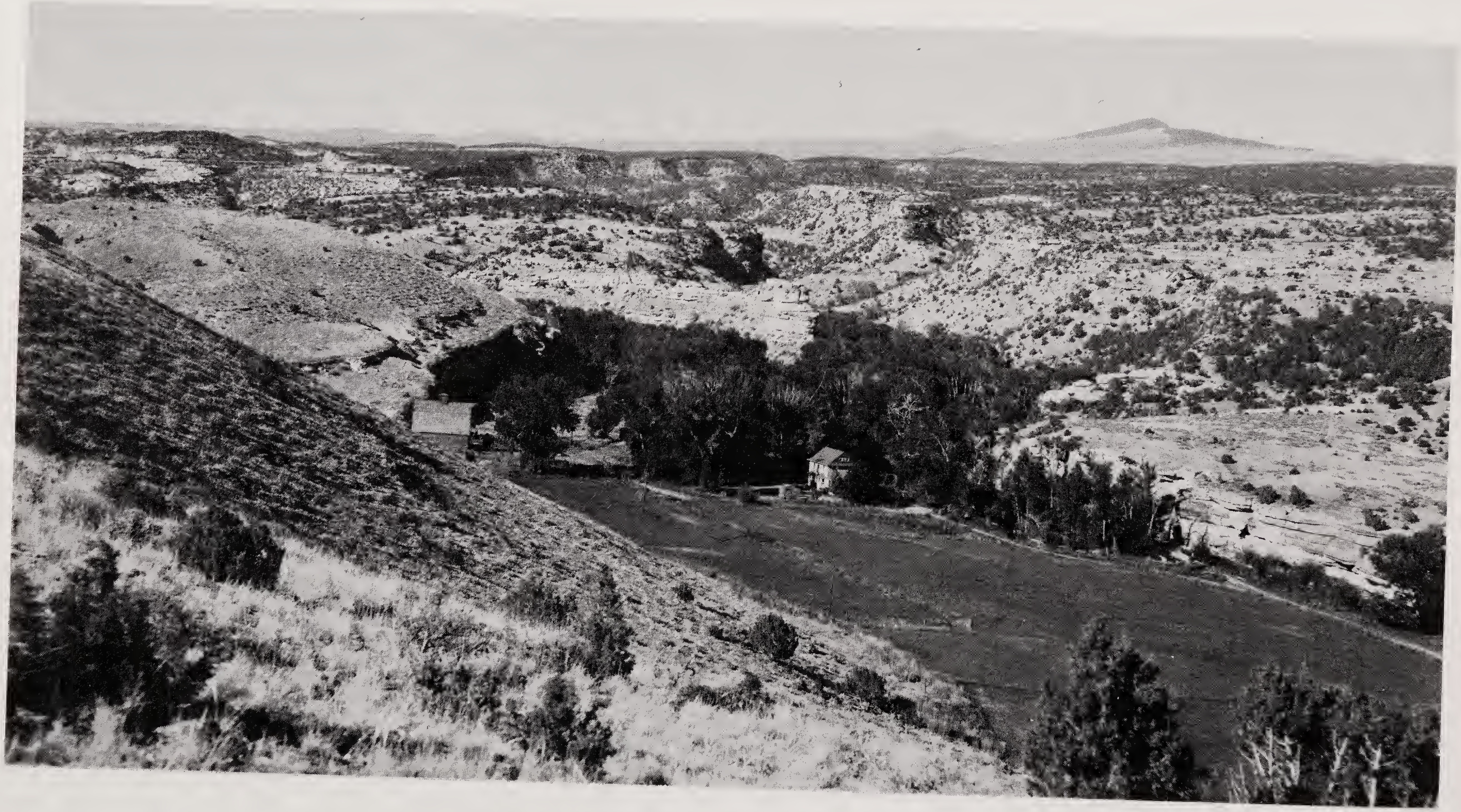


FIGURE 10.1. View of the Medicine Lodge Creek site area.

centered there. Data have been gathered under what has been called the Medicine Lodge Creek project, which centered around the Medicine Lodge Creek site (Figure 10.1). A number of peripheral sites chosen from a number of life zones have also been investigated.

These peripheral sites include Wedding of the Waters Cave (Frison 1962) in which a recent reinvestigation revealed a light Early Plains Archaic occupation. Others are two open campsites (Laddie Creek and Lookingbill) and four rockshelters (Paint Rock V, Granite Creek, Southsider Cave, and Rice Cave) at elevations from 5600 to 8500 feet (see Chapter 2), which demonstrate more intensive occupations during Early Plains Archaic. These sites, along with Mummy Cave (Husted and Edgar n.d.) and Bottleneck Cave (Husted 1969), have shown that much archeological evidence of the Early Plains Archaic at higher altitudes had previously been regarded as Middle and Late Plains Archaic because of inexact tool and projectile point typologies. What was in reality an Early Plains Archaic occupation was interpreted as a later manifestation.

PRESENT DISTRIBUTION OF FOOD RESOURCES IN THE BIGHORN BASIN

The food resources of the Bighorn Basin were and are determined largely by topography and climate. An altitude of around 5000 feet (1524 m) seems to have been a critical point. Within the basin there is an expanse of land 120 × 60 miles (193 × 97 km). The long axis of this expanse trends from southeast to northwest, at an altitude between about 3600 feet (1097 m) and 5000 feet (1524 m). This area covers about 7000 square miles (18,130 km^2) and is extremely dry. Yearly precipitation ranges from 5.25 inches (13.3 cm) to just over 9 inches (22.8 cm). In general, increases in elevation result in increasing moisture—except for unusual locations usually at the bottom of a deep canyon or narrow river valley surrounded by higher country.

In the southern and western parts of the basin, there is a considerable area between 5000 and 7000 feet (1524–2134 m) in elevation. In places on the west the area is from 25 to 35 miles (40–56 km) in width. To the south, although the area is not as extensive, the 7000-foot (2134 m) elevation line extends over the mountains to the southeastern slopes of the Bighorn Mountains. Land between 5000 and 7000 feet (1524–2134 m) demonstrates great improvement over the lands below 5000 feet (1524 m) at least in grass cover and consequently in animal carrying capacity. These areas were favorable for the larger herbivores, but communal bison kills were a rarity. Such kills did take place at the Horner site in Paleo-Indian times and in at least two other possible, but later sites. Significantly, the communal kills we know of are in the western area, where grass cover is better. In the eastern part of the basin, the area between 5000 and 7000 feet (1524–2134 m) is a relatively narrow band of deeply dissected, steep mountain slopes. In the Bighorn Mountains, at elevations above 7500 feet (2286 m), the terrain is of relatively low relief with heavy grass cover in open parks and some thick stands of timber. If our data are correct for this area, the resources from about 5000 to 9000 feet (1524–2743 m) were of special importance to the development and continuation of a number of prehistoric human occupations—those of the Paleo-Indian, the Altithermal (Early Plains Archaic) and those of the immediate post-Altithermal (Middle Plains Archaic). The rapid changes in elevation and consequent increases in precipitation combined with a wide variety of soils and landforms to allow a complex system of plant and animal communities.

We have not had much success in locating evidence of occupation for the period from about 8500 to 2000 B.C. in the interior basin at elevations below about 5000 feet (1524 m). Some resources were undoubtedly present there, but the greatest body of archeological evidence points to more concentrated economic resources at higher elevations and these zones largely determined the yearly round of transhumance. If the first 75 years of the twentieth century can be used as an indicator of the past, there were occasional years when above-normal precipitation greatly improved conditions within the basin. During these years, food procurement patterns could have been altered slightly to include more of the desert–basin and less of the mountain slopes.

Faunal Resources

The Horner site (Jepsen 1953) to date has provided the only evidence of large-scale bison procurement during the Paleo-Indian period. Otherwise bison occur only occasionally in archeological sites until the Late Archaic and Late Prehistoric periods when they increase rapidly. Bison are not in evidence until the Late Prehistoric period in any of the Mummy Cave deposits (Husted and Edgar n.d.). This is not surprising considering the site location in a river valley far back in the Absaroka Mountains. Caves straddling the Wyoming–Montana line in Bighorn Canyon produced only token numbers of bison bone (Husted 1969). The Medicine Lodge Creek site (Frison and Wilson 1975) also yielded very little evidence of bison. At higher elevations—7000 to 9000 feet (2134–2743 m)—our faunal evidence (although still scanty for the Paleo-Indian and Early Plains Archaic periods) indicates only an occasional bison.

Mule deer (*Odocoileus hemionus*) and mountain sheep (*Ovis canadensis*) dominate the faunal remains; antelope (*Antilocapra americana*) are surprisingly rare until the Late Archaic and Late Prehistoric periods. Nearly every cultural level at Mummy Cave produced some mountain sheep remains; deer were a rather distant second. Deer outnumbered sheep at Medicine Lodge Creek, but at the higher elevations in sites in more open, grassy country mountain sheep dominate the faunal remains until the Late Archaic, when bison became most common. The implications of this are that mule deer were as much adapted to rough country as were sheep, and that the sheep, although they liked being close to rough country, were strongly attached to open, grassy areas nearby. They have been pushed into unnatural habitat areas today but if undisturbed will still spend a good deal of time in open country. A single elk (*Cervus canadensis*) was recorded in a level dating about 8500 years ago at Medicine Lodge Creek; in general elk are quite rare in archeological sites until well into the Late Prehistoric period.

Smaller mammals, especially rodents and lagomorphs, were of importance as food if our evidence from Medicine Lodge Creek is an indicator (Frison 1976a). Wood rats (*Neotoma cinerea*) seem to have been of greatest significance although cottontails (*Sylvilagus* sp.) and jackrabbits (*Lepus* sp.) may have been a close second. All three species are found at all elevations. Carnivores including bobcat (*Lynx rufus*), badger (*Taxidea taxus*), black bear (*Ursus americanus*), and coyote (*Canis latrans*) appear regularly although in small numbers, and bones of these appear to have been treated in much the same manner as those of any herbivore—strongly suggesting their use as food. The rather unusual preservation of large numbers of fish remains at two late Paleo-Indian levels at Medicine Lodge Creek indicates their use as food. However, it is difficult to make any reliable assessment of their contribution to the total food supply on the basis of present evidence. Included were either lake chub or flathead chub (*Covesius plumbeus* or *Hybopsis gracilis*), sucker (*Catostomus* sp.), and either mountain whitefish or cutthroat trout (*Prosopium williamsoni* or *Salmo clarki*).

Caution is necessary in relating present behavior and distributions of animal species to the prehistoric periods. Introduction of domestic animals, control of predators, fencing, loss and change of habitats, controlled seasonal hunting, interruptions of transhumance patterns, transplanting of animal populations, parasites and disease introduced from domestic animals, artificial feeding, along with many other factors, have significantly altered the habits of most larger game animals. Some, such as the deer and antelope, have managed to adapt surprisingly well. Others, such as the elk and mountain sheep, have not fared as well.

Except for those relating to bison, the actual procurement methods used with the various faunal species in the Paleo-Indian and Early Plains Archaic periods can only be guessed. The Horner site (Jepsen 1953) must represent some form of communal bison procurement in the Bighorn Basin during Paleo-Indian times, but the site results have never been properly studied and reported. The terminal Late Prehistoric or protohistoric period demonstrates a widespread occurrence of mountain sheep and antelope trapping. However, the time depth of these practices is pure conjecture. No known site of the Paleo-Indian or Early Plains Archaic contains faunal remains suggestive of a large-scale sheep, antelope, or deer kill. However rather dramatic increases of mountain sheep remains in 2 levels of Mummy Cave dated at about 4400 B.P. and 1200 B.P. might be indicative of improved trapping methods (Husted and Edgar n.d.).

Deer could probably have been taken in the known types of mountain sheep traps but not in the antelope traps. Antelope are relatively easy to contain within almost any kind of continuous simple structure, especially something like a circle of brush with some kind of rope or cordage strung along the top. Antelope refuse to jump this kind of obstacle but deer will not hesitate to clear an obstacle several feet high.

One instance of rather intensive use of mule deer is known from the Sunlight Basin (see Chapter 6, Figure 6.16). The site, known as the Dead Indian Creek site (Smith 1970), dates from about 2400 B.C. and is affiliated with the

McKean Complex. The age structure at the site (based on ageable mandibles) indicates the animals were killed over a period of time, from about late October to early March (Simpson 1974). Evidence of special treatment of skullcaps of male animals with antlers intact was present. There is a suggestion here of possible communal mule deer procurement but the means is not known. This same site produced smaller numbers of mountain sheep and at least one elk along with many smaller animals. Grinding slabs and manos were also present.

Small-animal procurement methods are even more nebulous. The time depth of the classic Great Basin rabbit drives that were a common activity of Shoshonean groups (see Steward 1938) is unknown. A seemingly large number (135) of wood rats in a 9500-year-old bone midden at the Medicine Lodge Creek site apparently represents a number of animals taken during a short period of time—probably in late summer (Walker 1975). There is no reason to regard this as communal activity considering descriptions of a single Gosiute Indian in the Great Basin taking large numbers of wood rats with simple deadfall traps (Simpson 1876:53).

Plant Resources

The Bighorn Basin contains six major vegetation zones (Porter 1962). These include (*a*) desert–basin, (*b*) grassland, (*c*) foothill–scrub, (*d*) timbered mountain slopes, (*e*) alpine, and (*f*) stream bank communities. At present only one major attempt has been made to assess the plant potential as a human subsistence base in the Bighorn Basin area and this was in conjunction with the Medicine Lodge Creek site project (Galvan 1976).

The Medicine Lodge Creek site is probably the most complex campsite known in the Northwestern Plains. It spans a period of about 10,000 years of continuous use by a large number of human groups, none of which was very large. The actual area of site use through time shifted and changed in size as the lateral movements of a permanent and an intermittent stream that come together at the site varied. These conditions resulted in a good share of the site evidence being moved out of context, but fortunately much is still in place. The site location is at a transition between the desert–basin, grassland, and foothill–scrub zones and has the added advantages in terms of food resources of a stream bank plant community. Site elevation is 4600 feet (1402 m) but increases rapidly to the east. The diversity of plant resources within a zone of human exploitation may have been instrumental in determining the popularity of the Medicine Lodge Creek site through time.

An east–west transect of 8 miles was made with the Medicine Lodge Creek site at the center. It was felt that this transect would cross the greatest number of vegetation zones within a possible radius of exploitation by plant gatherers living at the site. The transect covered elevations from 4635 feet (1413 m) on the west to 6800 feet (2073 m) on the east. The investigator recognized five distinct vegetational situations in the transect range (Galvan 1976). These zones included the four already mentioned plus the disturbed area of the site itself and an area of saline soils dominated by *Atriplex* and *Sarcobatus.* Since the site area disturbance is recent it can be disregarded as significant. A total of 98 plant species were identified in the transect sample and at least 37 were at least potential sources of food.

According to Galvan, three general groups of foods can be proposed based on both kind and time of year of availability: (*a*) a spring and early summer group that includes greens and a number of roots and bulbs; (*b*) a late summer–early fall group of ripening fruits and seeds; and (*c*) fruits and seeds that remain on the plants during at least part of the winter.

The first group includes tender young stems and leaves of plants such as arrowroot (*Balsamorhiza sagittata*), beeflower (*Cleome* spp.), and chenopods (*Chenopodium* spp.); roots of the bitterroot (*Lewisia rediviva*); and bulbs of the sego lily (*Calochortus nuttallii*) and onion (*Allium* sp.). The second group includes fruits of chokecherry (*Prunis virginiana*), buffalo berry (*Shepherdia argentea*), and gooseberry (*Ribes inerme*); and seeds of yucca (*Yucca glauca*), Indian ricegrass (*Oryzopsis hymenoides*), wild rye (*Elymus canadensis*), and limber pine (*Pinus flexilis*)—to mention a few of the more important. Saltbush (*Atriplex canescens*) and amaranths (*Amaranthus* spp.) are examples of plants whose leaves can be eaten in the spring and whose edible seeds are available later on in the summer. The third group includes fruits of wild roses (*Rosa* spp.) and buffalo berries, and seeds of the saltbush (*Atriplex* sp.). A complete documentation of the plant food resources would expand the list considerably.

The fruits are generally confined to stream banks, areas close to springs, and the north slopes of canyons. Grasses are most prolific in the grassland–sagebrush zone but are also found in the foothill–scrub zone. Greens grow best along stream banks or in other areas of abundant moisture, although the arrowroot demonstrates its most prolific growth on steep talus slopes from low to middle elevations. The saltbushes favor saline soils of the desert–basin area. Root and bulb plants generally favor light, sandy soils from low to high elevations. Limber pines grow best in the rough, deeply dissected mountain slopes at elevations between 6500 and 8500 feet (1931–2591 m).

Quite a few of the plants mentioned grow at different elevations, so that at a given time a particular species might be mature at one elevation but not at another. Many plants (especially tender shoots and greens) are desirable as food only for short periods of time. With the proximity of resources at various elevations, the human group merely had to move short distances to prolong the period of availability. For example Leigh Cave, a small rockshelter site of the McKean Complex at an elevation of 5600 feet (Frison and Huseas 1968) with dry deposits, indicated intensive use of wild onion. The floor was covered with a hardpacked layer of outside coverings of wild onion (*Allium* sp.) bulbs up to 2 cm thick in places. Cooking methods are not known but roasting pits were present. At least nine other plants that could have been used as food were represented, including buffalo berry (*Shepherdia argentea*), cactus (*Opuntia polyacantha*), chokecherry (*Prunus* sp.), juniper (*Juniperus* sp.), limber pine (*Pinus flexilis*), thistle (*Cirsium* sp.), wild rose (*Rosa woodsi*), wild rye (*Elymus canadensis*), and yucca (*Yucca glauca*). The same site yielded parts of several hundred roasted Mormon crickets (*Anabrus simplex*). Insects were probably of minor value in the food total but there is no doubt that Mormon crickets were used. The same species was found in a protohistoric Shoshonean campsite along with some other insects (Frison 1971b).

The larger herbivores such as deer, mountain sheep, and bison that live in close proximity to ranges of mountains are able to follow patterns of transhumance in response to plant resources. There is an added impetus to these movements; although the lower elevations may have an adequate food supply during the hot summer, the grass is more tender and conditions in general more pleasant at higher elevations. Those same species of animals that live away from the mountains are usually tied to—and well adapted to—patterns of nontranshumance. But in the Bighorn Basin a good share at least of the large herbivore population can and does move from summer to winter feeding areas. Their movements would naturally affect the movements of human groups depending on them for food.

PREHISTORIC FOOD PREPARATION

Most of the foods hunted and gathered by human groups required some degree of preparation to enhance palatability and taste and to remove dangerous or objectionable parts. For example, the wood rat, an important food animal of the Gosiute of the Great Basin was given minimal preparation (Simpson 1876:53) and hard shells of grass and other seeds have to be cracked and the seeds reduced to grits or flour or they will not be digested but will pass right through the human digestive tract. Plains hunter–gatherers used a stationary grinding slab, usually a hard, fine-grained sandstone, in conjunction with a smaller hard stone or *mano* to crack the seeds (Figures 10.2 and 10.3). The grinding slab was pecked to form depressions that would catch and hold the seeds so that the mano could break them.

The appearance of such grinding tools can be documented at least by about 7500 B.C. at Medicine Lodge Creek. They appeared throughout the late Paleo-Indian and Early Plains Archaic periods, and their use increased and their quality improved in the Middle Plains Archaic or with the McKean Complex. It is difficult at this time to evaluate their true importance during the Paleo-Indian and Early Plains Archaic since they can almost be regarded as only prototypes of the later ones; but although the grinding slabs are relatively small and the mano stones lack the evidence of stylized manufacture and use demonstrated later on, they were still functional for seed grinding.

Similar grinding tools appeared in later Paleo-Indian sites in the same general area at the Bighorn Canyon cave sites (Husted 1969), at the Medicine Lodge Creek site, and at Schiffer Cave, a site out of the Bighorn Basin (Frison 1973a). The evidence now seems of sufficient magnitude to enable me to propose that seed-grinding tools were an integral part of the later Paleo-Indian cultural assemblages of the Bighorn Basin and were also of some importance to their economy.

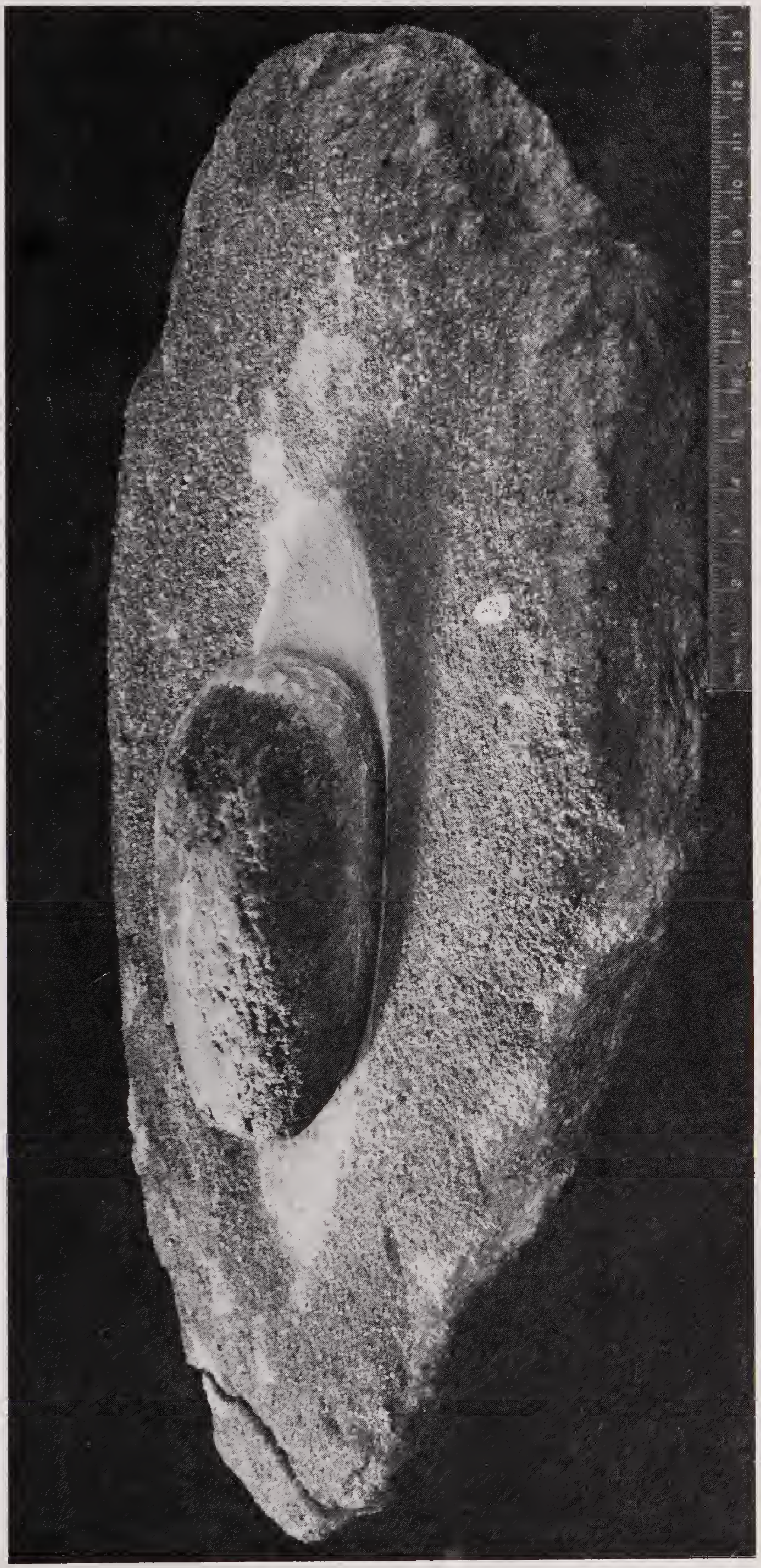


FIGURE 10.2. Grinding slab and mano.

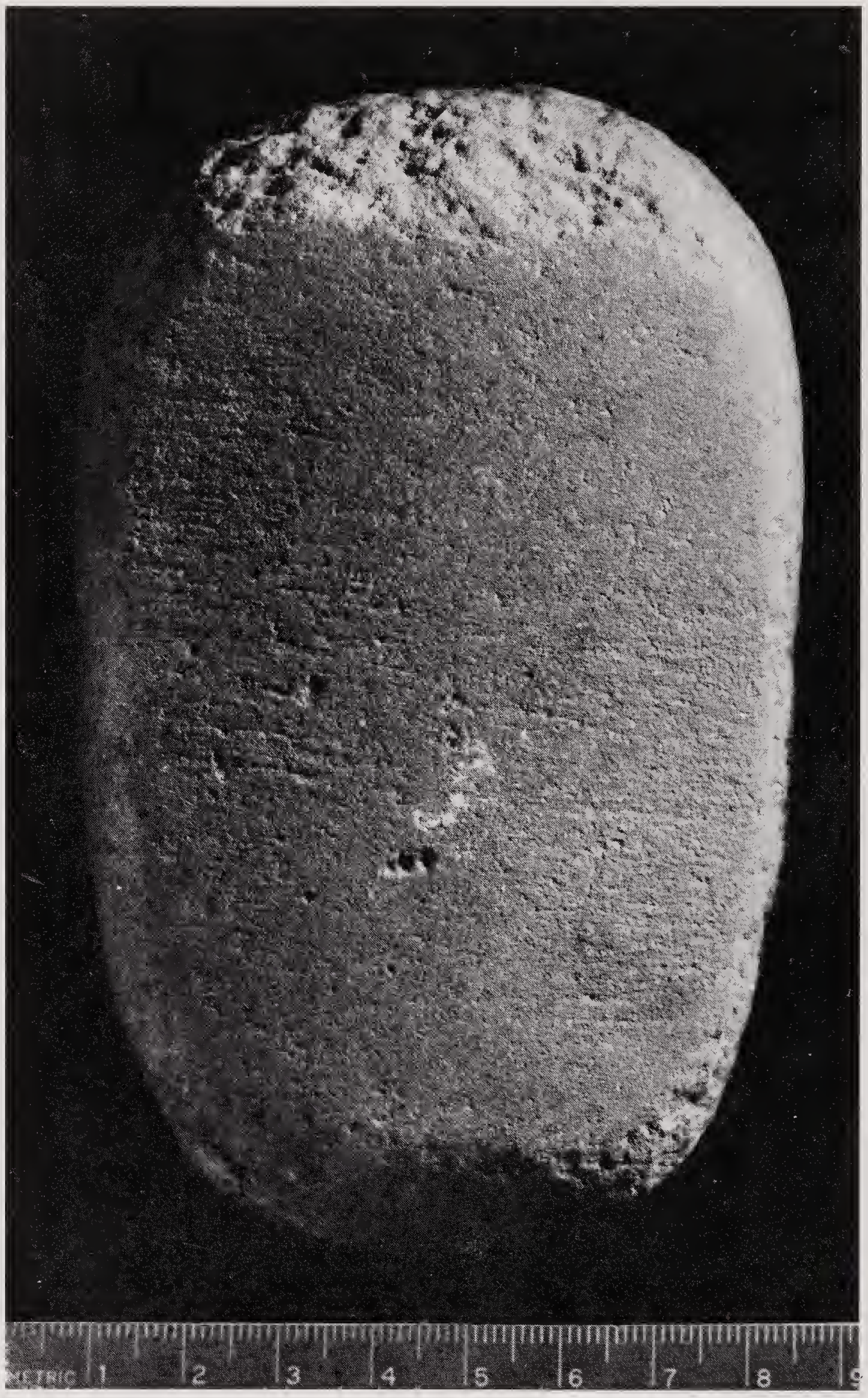


FIGURE 10.3. Typical mano stone.

Several investigations in Early Plains Archaic sites including Laddie Creek, Southsider Cave, and Carter Cave (this volume) indicate what can be interpreted as a marked improvement in grinding tools—especially in the manos, which begin to acquire more of the classic keeled forms of the Middle and Late Plains Archaic periods. The grinding slabs become longer, wider, and of greater thickness, which allowed deeper grinding depressions. Limestone grinding slabs were also occasionally used as well as sandstone.

The true function of grinding tools in the context described here is not entirely resolved. It is generally assumed that they were used for cracking the hard outer shells of seeds and breaking down vegetable products to increase digestibility. They may also have been used for reducing rodent bones to a paste (Mulloy 1954a:59). It is quite possible that a small-animal bone midden at the 9500-year-old level at the Medicine Lodge Creek site may have been destined for this kind of preparation. Rodent bone numbers in most sites do not seem commensurate with their availability, which may indicate that small animals were not extensively used, that the remains have not survived, or that the bones were somehow utilized for food. The Medicine Lodge Creek bone midden mentioned contained 40 species representing a minimum of 655 individuals (Frison 1976a:161; Walker 1975) and suggests that we ought to consider seriously past means of utilization of rodent bones and that we should also make quantitative evaluations of their food value.

FIRE PITS

Beginning with the Middle Plains Archaic and continuing up to the historic period, the most common and widespread archeological features on the Northwestern Plains are artificial pits of varying sizes and shapes filled with fire-fractured rock, ashes, and charcoal (Figure 10.4). Round or oval-shaped in outline, they are usually carefully made and generally symmetrical. Diameters vary from about 1 foot to nearly 3 feet and bottoms are usually rounded but occasionally flat. Some are globular and have their maximum diameter at the ground surface whereas others have their maximum diameter well below the ground surface where soils are stable enough. Others expand from the surface to either a flat or rounded bottom and still others are bell-shaped. The sides of some were lined with carefully fitted sandstone or limestone slabs; sometimes the bottom and parts of the sides were lined with river cobbles. Some are relatively deep and contain more than one sequence of fire and cracked rock. In some cases fire-fractured stones cover the ground around the pits indicating that the pits were cleaned out and reused. The sides of the pits are often oxidized to a thickness of 2–4 cm, indicating intense heat over long periods of time. These kinds of features are sometimes associated with stone circles or tipi rings (see Mulloy 1954a, 1965a; Mulloy and Steege 1967).

A general interpretation of these features is that they were used for cooking food products. Stones were placed on a bed of hot coals in the pits; when heated, the stones served as a source of heat for cooking. Whatever was to be cooked could have been put in a green hide, animal paunch, or fiber bag, placed directly on the hot stones, covered with earth, and left for a period of time. With practice this can be done without burning or contaminating the food. The heat usually fractured the stones so that they were of no further value and another pit was dug or else the old one was cleaned out and fresh rock was used. This kind of use is clearly demonstrated at the Wardell site (Frison 1973b) where an unopened pit contained several parts of a bison carcass or carcasses that were being cooked (Figure 10.5). Pits of this nature were also used to heat stones for stone boiling, during the Late Prehistoric period at least (Figure 10.6).

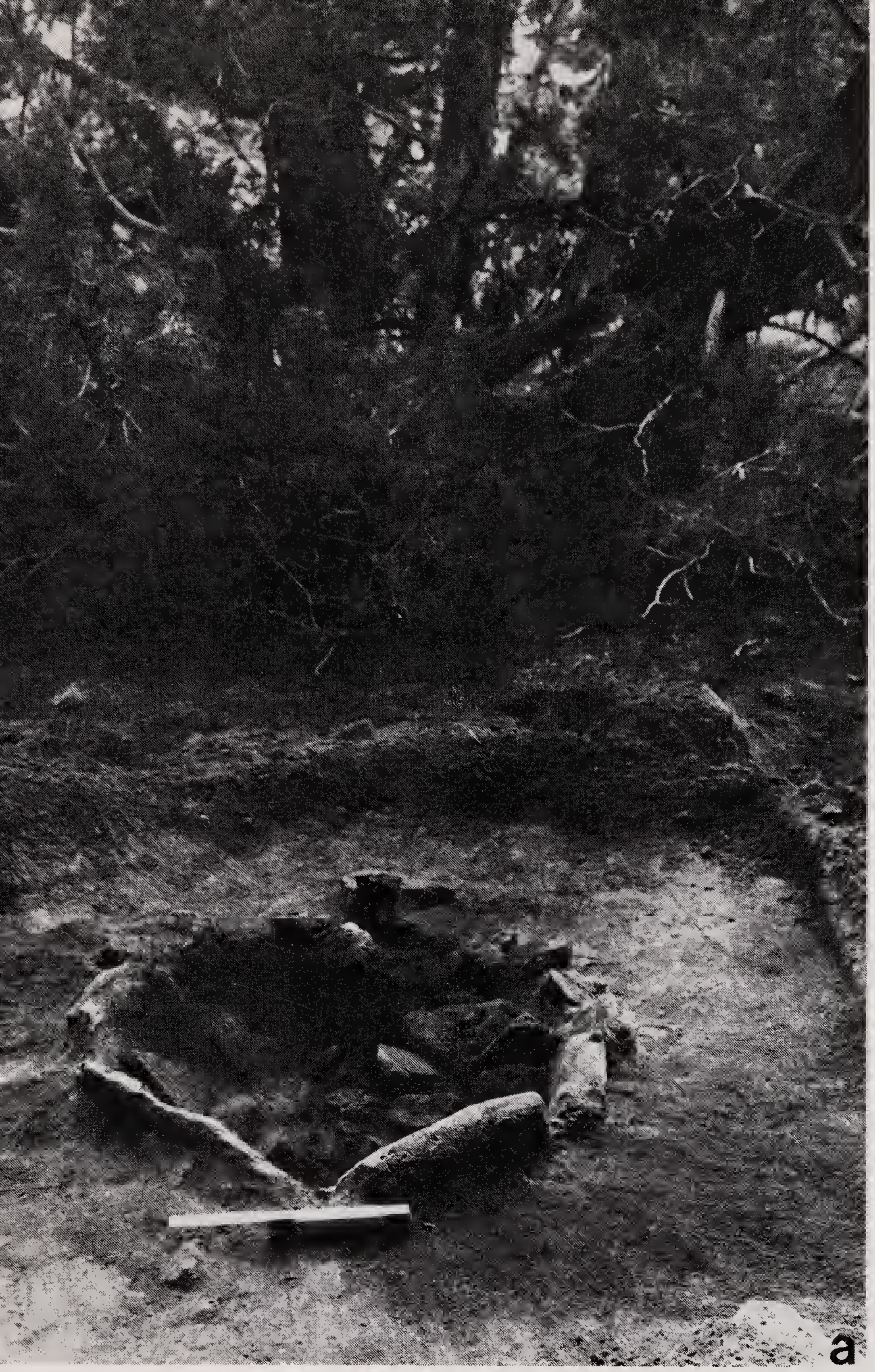
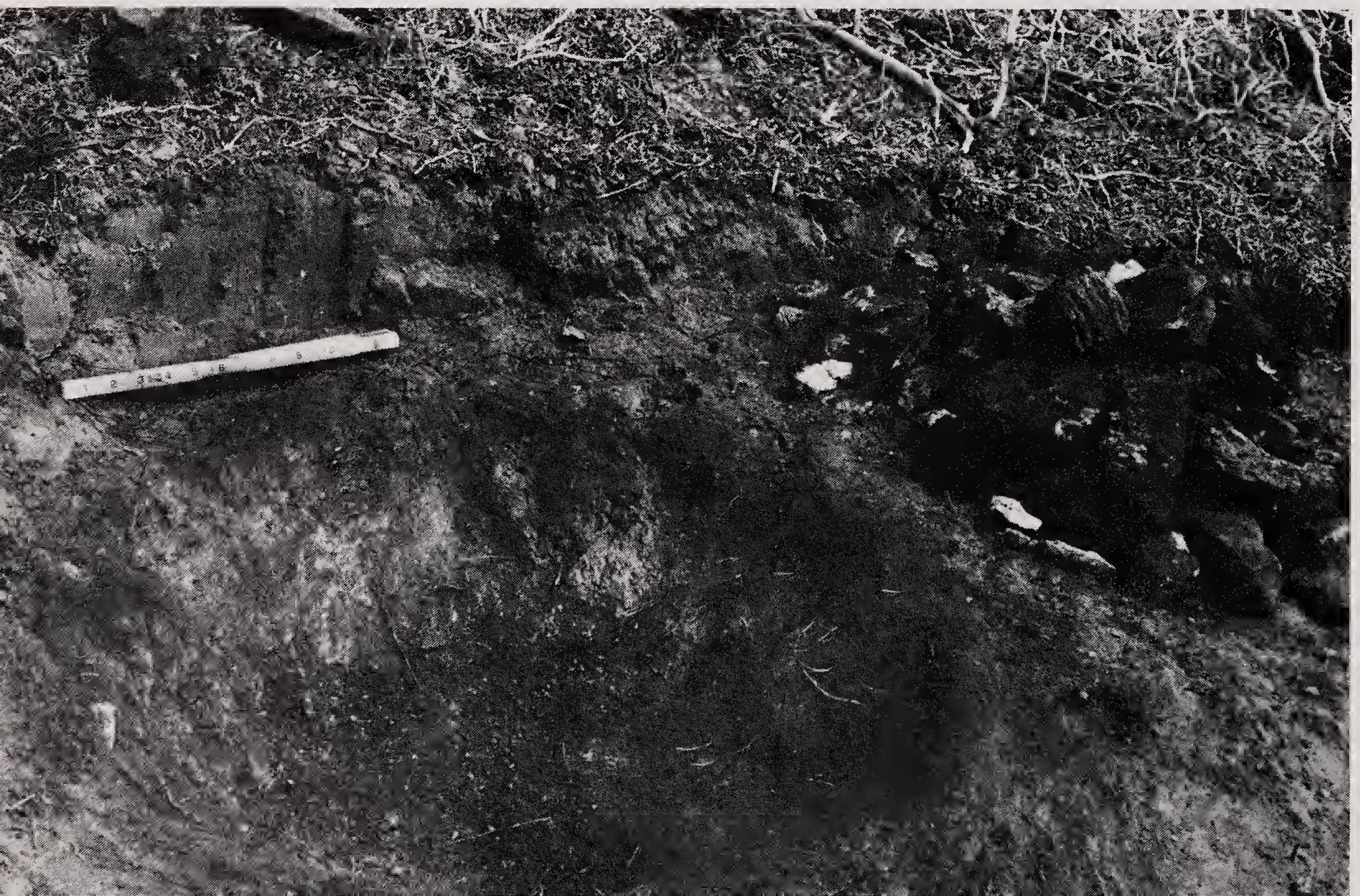


FIGURE 10.4. Fire pits of the Late Prehistoric (a) and Late Plains Archaic (b) periods. Note that the fire pit in (a) is slab-lined.



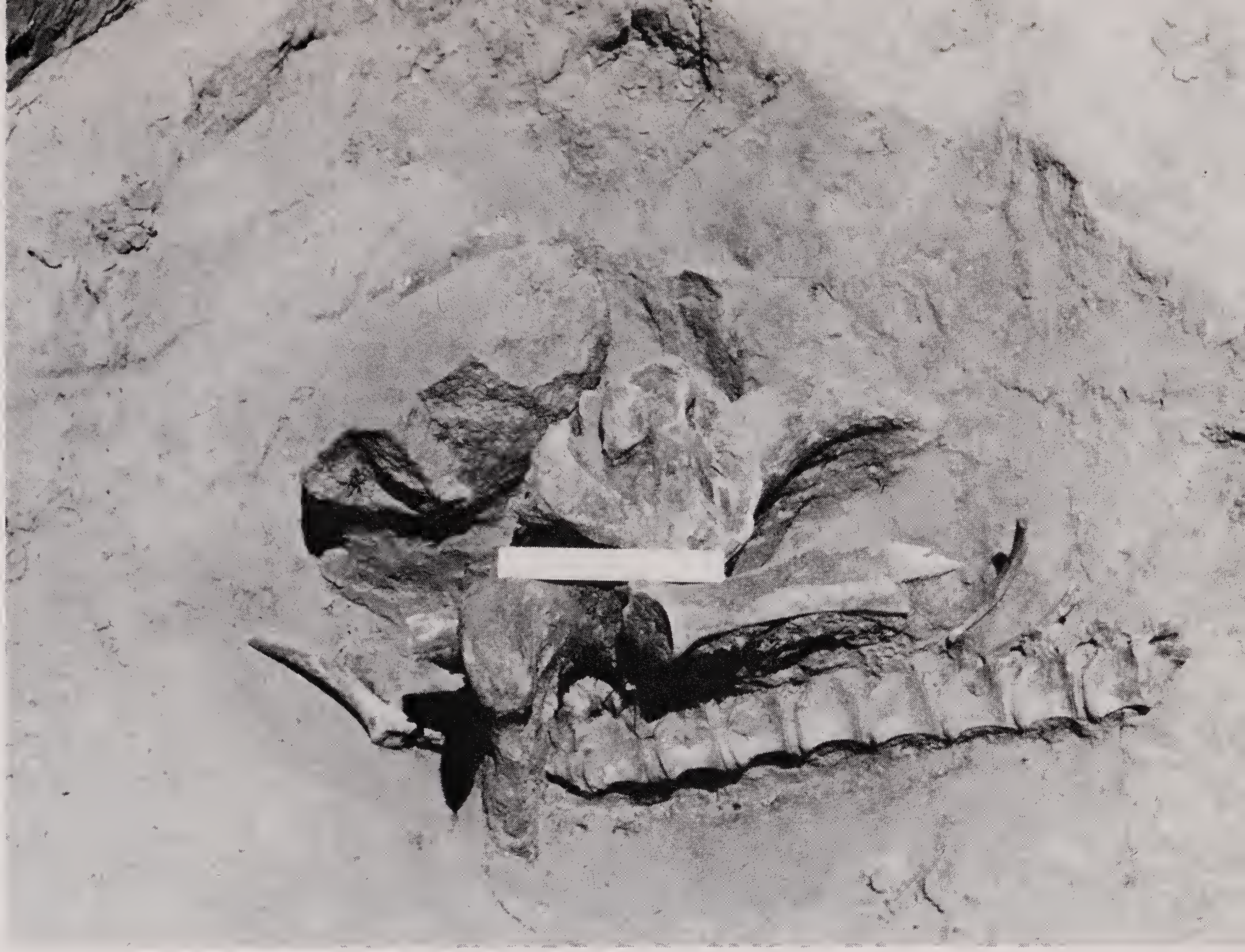
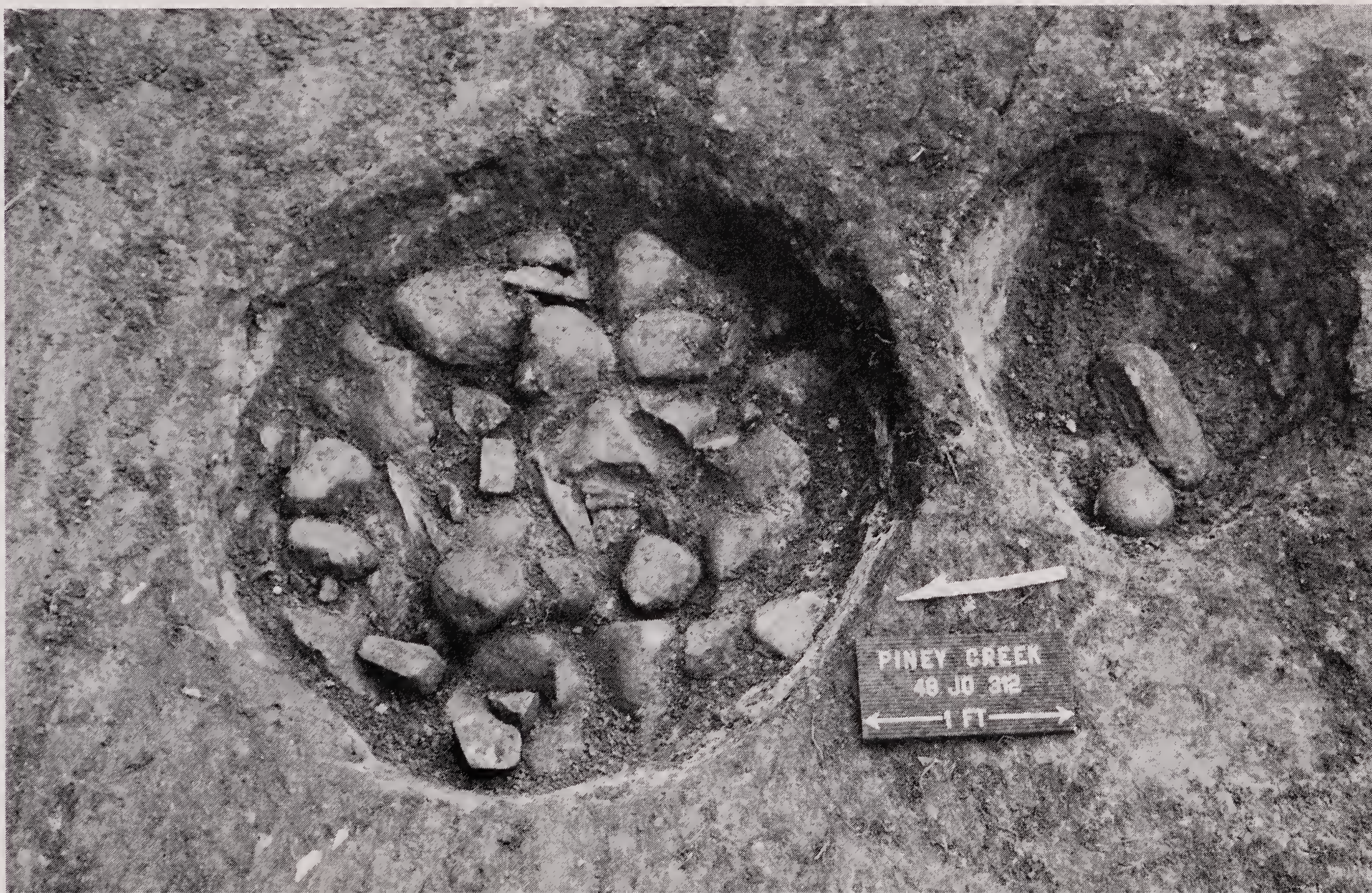


FIGURE 10.5. Cooking pit at the Wardell site.

FIGURE 10.6. Stone-heating pit (left) and stone-boiling pit (right) at the Piney Creek site.



We should also consider the possibility that these pits were used to heat small structures during cold weather. Many fire pits are situated in areas of south and east exposures. A deep pit with several pounds of hot stones covered over with a thin layer of earth would have warmed the surrounding earth and kept the space inside a small structure warm for several hours. Such uses need to be considered, since winter survival on the Northwestern Plains has not been satisfactorily explained—at least on the basis of present evidence.

PROTECTION OF STORED FOOD SUPPLIES

Protection of stored food must have been a major problem. Dry storage seems to be the most practical for this area given present conditions. Heavy periods of rainfall are common during late summer and fall, which would require deep storage. Access to such storage could have been difficult later in the year, when the ground was frozen. On the other hand dry rockshelters are a common feature, but there are dangers here also for stored materials. Small rodents do surprising amounts of burrowing, as do larger animals such as badgers, who are in search of the rodents. Stable, dry deposits some distance away from the rockshelter walls but behind drip lines would be the optimum sites for storage pits, as rodent activity usually centers around the damp contact area between the bedrock and cave fill.

Many of the details of past food-storage methods are conjectural but at least some evidence of dry-storage features in rockshelters and caves is suggestive. In some of the Paleo-Indian levels at Medicine Lodge Creek (see Frison 1976a) there are small, globular pits that may have been used for food storage. These vary in size from about 10 inches to 20 inches (25–51 cm) in diameter, and some that were dug into a compact deposit of clay were almost spherical in profile, with the opening slightly smaller than the diameter. Others dug into less consolidated materials have the same rounded bottoms but perpendicular sidewalls. In three levels, 14 of these pits (Figure 10.7b) were found in a unit 2 m^2; in another unit and at a different level, six of these pits formed a circle around a central pit (Figure 10.7a). They were filled with what appears to be trash from an occupation floor and, although some charcoal was present, they were not fire pits and contained no evidence of having had fires in them. First believed to have been used as food preparation pits, they are now believed to have been used for storage, especially since they were not associated with fire-fractured stones common to other food preparation features. It is reasonable to theorize that these pits were used from year to year and that they were filled with something when not in use to prevent the sidewalls of the pits from collapsing.

Similar features were found nearby in Schiffer Cave, a dry rockshelter on the eastern slopes of the Bighorn Mountains (Frison, 1973a), in a Paleo-Indian context of a slightly later cultural horizon than the one mentioned at Medicine Lodge Creek. The deposits at Schiffer Cave were dry and contained considerable quantities of dried and partly charred seeds of several genera including *Helianthus, Opuntia, Amaranthus, Prunus, Pinus,* and *Juniperus* and several

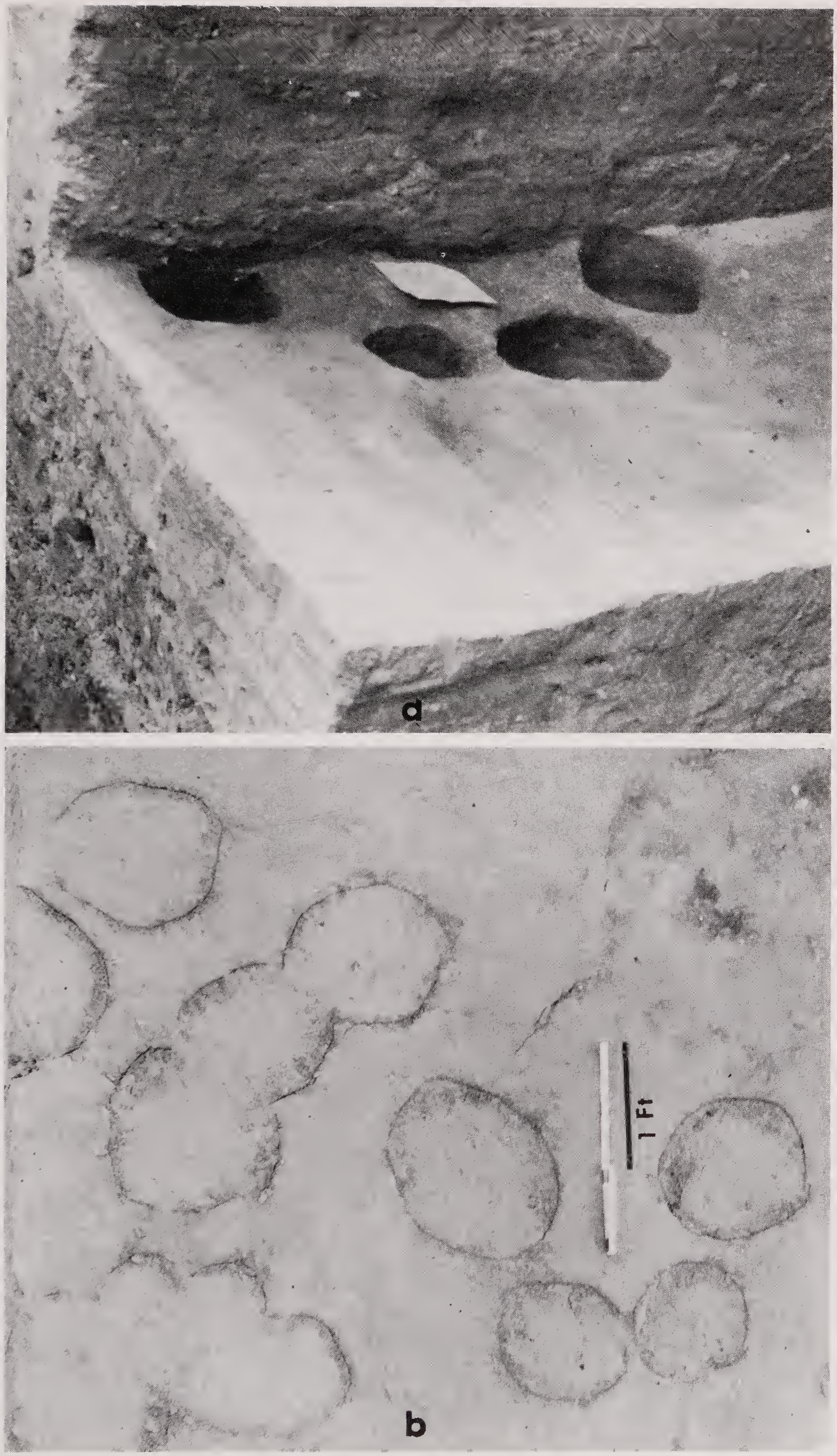


FIGURE 10.7. Presumed storage pits at the Medicine Lodge Creek site.

unidentified ones. The circumstances suggested strongly that larger quantities of these seeds might have been present in a storage situation. The Medicine Lodge Creek deposits were not dry, because of the aggraded material deposits above the Paleo-Indian levels. Subsequent percolation of water down to the Paleo-Indian level probably contributed to the loss of perishables. A few charred seeds were found in the Medicine Lodge Creek deposits but so far we have only been able to identify small numbers of *Juniperus* and *Prunus*—which is suggestive but not conclusive of the pits function as storage areas. Large numbers of fire pits were described in the lower levels of the Bighorn Canyon sites (Husted 1969) and several of these were filled with ash and bits of charcoal. There is a strong possibility that some of these served as storage features since they appear similar to those just described.

During the summer of 1976, investigations were initiated at the upper foothill–mountain slope areas in the Bighorn Mountains in an attempt to resolve problems of the Early Plains Archaic or Altithermal period. A rockshelter at about 7500 feet elevation provided evidence of possible food storage features. These were pits somewhat larger (30 inches or 75 cm in diameter) than the ones previously mentioned and were also later in time by at least 1000 years. Dampness caused loss of perishable materials here but there was no evidence of fire or food preparation. A number of flat stones were associated but they had not been heat-fractured and their positions suggested that they were used as coverings for the features. There were, however, many other features that were fire pits and food preparation pits. This accumulation of data now provides strongly suggestive evidence for simple food storage among Paleo-Indian and Early Plains Archaic cultural groups in the Bighorn Basin and the concept of storing provisions constituted a small but vital link in the yearly round of subsistence activities.

CLOTHING

In conjunction with heat and shelter, winter survival required some kind of fairly sophisticated clothing. Actual evidence for this is scarce but some evidence is strongly suggestive. Many site assemblages contain the tools that could produce this kind of clothing. A wide variety of twisted fiber cordage and fragments of hide sewed with the same material indicates that the technology to manufacture reasonably sophisticated clothing existed at about 2000 B.C. (Frison and Huseas 1968); we have no reason not to accept a much greater time depth. Clothing on a mummy at about A.D. 700 (Husted and Edgar n.d.) and footgear from the same site component provide further evidence of the ability to produce adequate winter clothing.

Footgear in particular must have limited hunting activities during periods of extreme cold. Frostbitten feet require a long time to heal and if severe enough, they never heal completely. Prehistoric man was most certainly aware of these dangers and took the necessary precautions.

To conclude, the Clovis occupation in the Bighorn Basin as represented at the Colby site suggests a strong hunting orientation. The presence of a possible grinding stone is suggestive but in no way conclusive of vegetable food preparation. However, the distribution of Clovis projectile points from the lower elevations to nearly timberline and in a wide variety of ecological niches could indicate more than a strictly hunting economy. Gathering of plant food and small animal collecting was probably important also. The Hanson site strongly suggests hunting and gathering during Folsom times as opposed to a strictly hunting orientation. After this, there is unquestionable evidence of a large number of cultural groups from the later Paleo-Indian to historic times that were all apparently strongly oriented toward hunting and gathering. The evidence can be found in a number of contexts including settlement patterns in relation to the distribution of plant and animal resources; site artifact assemblages; and site features. Taken together, the evidence suggests well-established, nomadic cultural groups adapting successfully to a relatively harsh environment that witnessed many short- and long-term climatic changes. Hunting was probably the prestige activity but subsistence depended on both hunting and gathering. Scheduling of economic activities in response to food resource availability was the key to year-to-year prehistoric survival on the Northwestern Plains. Communal animal kills may have been carried out primarily as social events and to ensure surpluses for storage; they were probably not everyday hunting practices. A stronger commitment to hunting may have prevailed in areas of the Northwestern Plains that provided better animal carrying capacity than the Bighorn Basin.

11

Concluding Observations and Remarks

Every hunting group claims an aggregate of hunting strategies in the same sense that they claim social organization, political structure, and other societal institutions. The hunting strategy pervades all institutions of society to the extent that many kinds of limitations are placed upon hunting activities. We know for example that Shoshoneans in the Great Basin would not trap antelope unless the proper antelope shaman was present, and communal bison hunting on the Plains was carried out in a context of supernatural restrictions. Hunting was a significant part of the economy of prehistoric societies and as Polanyi (1957a, b) pointed out there are quantitative differences between the economic thinking of a hunting and gathering society where acquisition and distribution of food are based on kinship and basic reciprocity and the economic thinking of our own system of supply and demand. Even so, basic hunting processes have not changed too much from primitive to modern societies with the exception of improved weaponry and different motives.

The business of hunting in prehistoric hunting and gathering groups comprised a body of day-to-day activities and oral tradition that may have been as extensive and as complicated as the manifestations of kinship. No self-respecting anthropologist would attempt to analyze the kinship institutions of his group without some intensive and systematic training. But most observations on hunting have been done by persons totally inexperienced in either the ways of hunting or the behavior of the species hunted. Some insight into prehistoric hunters and hunting from this somewhat different perspective might be of interest. On the other hand, hunting can never be fully understood in an anthropological sense until the investigator has had to fill his empty stomach by means of his own expertise and ability as a hunter.

It has been emphasized that with modern hunters and gatherers the gathering done by women produces more of the total caloric intake for the family than does the hunting by the men (see, for example, Lee and DeVore 1968). Gathering success is more predictable than hunting; as expressed by Lee (1968), "Hunting is a high-risk, low-return subsistence activity, while gathering is a low-risk, high-return subsistence activity [p. 40]." The concept that the environment is the storehouse and can be drawn upon as needed has also been expressed (Lee and DeVore 1968:12).

Some of these concepts need to be explored further in terms of the prehistoric hunter on the Northwestern Plains. First, the situation with regard to hunting and gathering changes rapidly from place to place as topography, elevation, soils, and climatic factors vary, and since climate is always changing the distributions of plant and animal food also change. In areas such as the Bighorn Basin of northern Wyoming, gathering may have overshadowed hunting, at least in the post–Paleo-Indian periods—as long as procurement of smaller mammals including rodents, insectivores, and lagomorphs is regarded as gathering, which seems reasonable. Looking at the area of the Northwestern Plains as a whole, it is difficult to decide which economic orientation, hunting or gathering, actually provided the most food; but I would argue that the scales were tipped at least slightly in favor of hunting. This did not allow the women to be idle since the activities of caring for animal products was time-consuming and made up for decreased plant food gathering.

The contention that gathering is a low-risk activity whereas hunting is a high-risk activity needs to be considered further. The woman gatherer can locate a hillside covered with sego lilies or wild onions, a berry patch, a field of grass or salt sage, (*Atriplex*) and then state with absolute certainty than she can gather enough for a meal. The hunter, on the other hand, can observe his hunting ground and determine the presence of animals. He cannot state with absolute certainty that he will obtain an animal. In this sense, gathering is low risk in comparison to hunting. However, the hunter who has located his animals, knows his hunting territory, and knows his animals' behavior will seldom be faced with an empty stomach.

On the Plains, the large communal kill is used as evidence that in many cases more animals were taken at one time than could be consumed. The environment was the storehouse, but the hunting group was aware that sometimes the storehouse door would be locked and some provision had to be made for such periods. This provision had to be through some kind of preservation and storage and undoubtedly included both animal and plant products. For this reason there were times when more was taken from the storehouse than could be used at the time. The situation on the Northwestern Plains was on a gradient somewhere between the intensive storage of surpluses by the Arctic peoples, and the lack of storage in those areas where seasonal conditions place essentially no restrictions on economic activities.

Hunting is traditionally a male activity and it is also a prestige activity. This is attested to in all hunting societies where the male who is the best hunter receives the highest recognition from the others in the group. Only a small percentage of the world's population engage in true hunting activities today, and an even smaller number participate in hunting as a serious economic activity. Even so, some thoughts regarding the basic philosophy of present-day hunting might be worthwhile pondering.

To the addict, hunting is a drive as powerful as any of the more familiar basic drives. Hunting is now restricted to seasons, so the hunter is usually forced to wait until sometime in the fall of the year when the season is open. At this time the true hunter deserts family, business, and any other responsibilities and takes to the hills. Many communities in the hunting areas dismiss school for the opening days of the season. They have learned that a large share of the school-age males old enough to participate in the hunting will be gone and it is useless to try to carry out normal routine. It is a bad time to become sick; the doctor is likely to be away in the hills; so are those who provide many other services. Only after the hunting season ends do conditions return to normal.

During the course of several years of hunting and guiding hunters, I have made many observations on human hunting behavior. Although some women like to hunt and are good hunters, hunting is largely a male-dominated activity. Some of the charm of hunting for males may be that a group can get together for a period of time and engage in purely male activities. Hunting brings out different facts of human behavior. The staid businessman can lose his composure completely at the sight of a trophy animal. Persons will suffer extreme discomfort and deprivation to pursue game animals. They will sleep in tents during the worst kind of weather, eat ill-prepared food, spend long hours at the most difficult kind of work. It appears to be a reversion to an earlier, primitive form of living. It is certainly not possible at this time to justify hunting economically. Most anyone who takes the time to calculate it on a cost per pound basis finds that prime beefsteak is much cheaper than deer, elk, or other wild game.

Success is all-important in hunting and it is considered somewhat of a disgrace to return home without something to show the neighbors. Toward this end, the wise hunter of today who is usually limited in terms of time and who is going into strange territory will either take along someone familiar with the area or hire an experienced guide. There is an unwritten code, however, that a man should kill his own game. This means that the guide does all he can to get his client into the proper position but the hunter himself must pull the trigger. The guide hopes the hunter's rifle is properly sighted in and that the hunter will not be too winded from exertion and so excited from the sight of the trophy that he will suffer from "buck fever" and miss. If he does miss, the guide is expected to go through the same process again, because the reputation of the guide depends entirely on the number of hunters he sends home with their trophies.

Strangely enough, this person who has pulled the trigger that resulted in firing the weapon that killed the animal can now claim the status of a hunter, although he has been taken to the hunting area, fed and taken care of, led into position, and has had his game pointed out to him. He has the trophy to prove it, although in reality someone else has done his hunting for him. The point I am stressing is that it is now possible to buy the prestige a hunter once had to earn.

Hunting methods have changed because technology has changed. Weaponry has improved to the extent that the deficiencies of the hunter are balanced somewhat by a firearm that has a nearly flat trajectory for several hundred yards and a sighting device that requires only placing a cross hair on a magnified view of the animal. The projectile delivers enough shocking power that impact with about any part of the animal brings the animal down. As a result the hunter no longer has to stalk game or track it down after it has been hit. The initial pursuit of the animals can be done with ease and comfort in a variety of all-terrain vehicles. Clothing is now of such quality that extreme cold and wind are hardly felt. Optics make up for untrained eyes and reveal the presence of animals that might otherwise go unobserved. All these increase the hunter's chances of success but do nothing more than replace attributes that were formerly acquired only through a long period of training and experience.

Perhaps the most significant thing that has disappeared from hunting is its purpose: It is no longer something pursued to fill one's stomach. In the West and other areas as well during the depression years of the 1930s hunting was a serious business and an important source of food for many families. Ammunition was relatively expensive, money was scarce, and shots were not to be wasted. The result was a generation of good hunters who were strongly motivated and who learned that an empty stomach went a long way toward sharpening one's hunting abilities. They became familiar with certain hunting areas; they developed a set of hunting techniques for these areas; and they felt insecure hunting out of the familiar areas. Year after year they would return to the same area with confidence of success because they knew from experience the game would be somewhere about even though the problem of exactly where would change from time to time. They were aware of hunting strategies that would bring success regardless of conditions that affected animals such as weather, feed, and time of year. Also there was enough space so that hunting pressure was not excessive in any given area.

They were hunting for the sole purpose of filling the stew pot. Antlers and horns were secondary; a hunter would usually take an animal for its condition and the promise of future eating rather than as a trophy to hang on the wall. This group of hunters operated according to a code that dictated that meat was not to be wasted. Anything killed was utilized to its fullest extent. There was careful consideration also as to where animals were killed; nothing was killed where the effort of recovery exceeded the value of the meat or where the cutting up and transport would result in dirty or spoiled meat. Animals in poor condition were left. Animals killed were done so with a consideration of the weather so that they would not spoil. Hunting was carried out as a means of acquiring a valuable economic good and all efforts were made to keep it that way.

On the other hand, there is something of the trophy hunter in every hunter and even the avowed meat hunter will at some time acquire an unusually fine set of antlers, horns, or something to claim status among his hunting peers. This feeling has led on the one extreme to a record book in which the dimensions of the largest trophies are measured, confirmed, recorded, and ranked in proper order; considerable prestige accrues to the persons who can claim the largest and best trophies. The prehistoric Plains hunters must have felt a little of the same toward game animals, if we can judge from the contexts in which large animal heads have been recovered. Examples include special treatment of especially large deer antlers still attached to skulls (see Chapter 6, Figure 6.16); features such as circles and lines of large bison skulls in kill sites; large male bison skulls placed around the perimeter of structures associated with bison kills; and a large set of elk antlers placed in a prominent position in a protohistoric Shoshonean camp. In the prehistoric situation it is difficult to distinguish between trophy taking and religious practice although the two were probably closely related.

A realistic hunting strategy model for the prehistoric Plains hunter must be constructed from a broad data base. The sources of data include the archeological record, ethnographic accounts, observations by early Plains travelers, studies of present-day hunters and gatherers, and studies of animal behavior in terms of human predation. A hunting strategy model needs more than the observing of a group of hunters from the time they leave camp in pursuit of the animals until the animals are dead.

For the prehistoric hunter, hunting strategy began the moment he awoke and observed conditions outside his abode. His decisions were based on the present conditions and past experience. His observations usually told him within fairly close limits where the particular species of animal he wished to hunt would be located and what the animals' reactions on that day would most likely be. Decisions beyond this had to be made as the hunting situation progressed, since no two hunting events are exactly alike and animal responses are predictable only within limits. Judge's excellent work in New Mexico (1973) demonstrates a Paleo-Indian hunting strategy determination for a certain area, but there is no reason to expect that the same hunting strategy determinations are going to hold in other areas having different distributions of water and feed, different topography, and different animal utilization patterns.

The education of the prehistoric hunter began at an early age. By the time the hunter was accorded full status within his group he was intimately familiar with a surprisingly large body of knowledge concerning the animals he hunted. His acquisition of hunting knowledge continued until the day he stopped hunting. Man is the best and most efficient of all predators and considering the broad hunting interests of the prehistoric hunter, he had to acquire a body of knowledge that could be depended upon to provide the proper decision regardless of what animal crossed his path on any particular day of the year.

The ingredients that go into any given hunting strategy are many and varied, whether it is conceived ahead of time or it develops as the hunt progresses. A list of some of these illustrates the complexity involved in the education of the hunter.

Familiarity with hunting territory has always been stressed and is of extreme importance because the topography, vegetation, and location of water sources will determine to a large extent how a given animal of a given species will react to given stimuli. Each animal species hunted has a unique set of behavioral patterns. Bison, moose, elk, deer, pronghorns, jackrabbits, or mice react differently to the same stimuli. In each species females behave differently from males, and the young behave differently from the old. All behave differently in the morning compared to the afternoon or evening. Rainy day behavior differs from clear, snowy or windy day behavior. Cool weather brings on different behavior than warm weather. Seasonal changes are particularly noticeable in terms of hunting. All animals respond differently in spring than they do in summer, fall, or winter. Biological changes in the animals are also important. Birthing-season behavior is radically different from that of the rutting season. Animal condition introduces another set of variables. An animal in good condition responds differently than the same animal in poor condition. A male deer in velvet acts much differently than he does after his antlers are fully developed. His behavior changes once more as the heavy antlers loosen each year just before they fall off. The list could go on indefinitely.

The knowledge necessary for formulating hunting strategies is further multiplied because of the different requirements for single-person hunting, small group hunting, and communal hunting. Individual and small group hunting is less disruptive to the resident animal population than communal hunting. Some species are more amenable to communal hunting than others and the combinations and permutations of hunting strategy decisions become astronomical in number.

Most animal species in the New World or at least their close relatives are still around for close observation in the wild or semiwild state. Their ranges of behavior have been observed quite closely in terms of building up a procurement model. This information is unfortunately lacking for the mammoth, and as a result the mammoth procurement model is extremely tentative and conjectural. I feel that the use of the African elephant model is productive but must be used with extreme caution. In the same way, the generalization of modern bison behavior to that of extinct variants of bison needs to be used with extreme caution. Even so, the working hypothetical model of mammoth procurement based on Colby site evidence and on the secondhand observations on elephant behavior presented earlier could have merit, even though the model will certainly be refined and changed as more and better data are recovered.

One limiting factor in the prehistoric hunting procurement model was the weaponry used. Experimental use of thrusting spears, atlatl and dart, and bow and arrow on live animals is being pursued very cautiously. I believe this experimentation is beginning to offer pertinent data toward a better hunting strategy model. Other approaches to the problem of prehistoric hunting strategy models will probably appear as studies on the prehistoric hunter progress.

A last reflection on hunting is that constraints have been placed on hunting by both prehistoric and present-day societies. In the prehistoric situation, the constraints resulted largely from supernatural beliefs and were manifest by such things as observing ritualized behavior so the animal spirit world would not be offended. Some constraints may have been more practical, such as punitive action taken against the individual hunter who jumped the gun before a communal hunt.

Today the idealistic view of hunting rules and regulations is that they are designed to preserve hunting as a sport. Hunting is no longer economic and has been channeled into a conceptual pattern that rationalizes it as a balanced contest between hunter and hunted, which is a fallacy. A good hunter observing an animal population with the idea of food procurement knows the animals have no chance although the exact moment of success is not predictable.

Although hunting has been stressed in this study of prehistoric adaptations on the Northwestern Plains, the true nature of the cultural groups involved will never be fully understood until the relative importance of plant food to their economy is known. Only a few scraps of sound evidence that tell much of past human plant usage have been recovered. For example, seeds representing a number of species have been recovered from what may be storage pits in the Paleo-Indian period (Frison 1973a) but in the context of a foothill–mountain oriented group that was apparently more of an Archaic group than a hunting one. The floor of a cave dating from the Middle Plains Archaic was matted with the outside coverings from wild onions (*Allium* sp.) along with the remains of a number of local fruits and seeds. Remains from several hundred roasted Mormon crickets (*Anabrus simplex*) were present also. Plant fiber cordage for sewing hide was also found (Frison and Huseas 1968). The scarcity of large animal remains in both sites suggests a strong dependence on gathering of plants not only for food but for utilitarian purposes as well. A Late Prehistoric or protohistoric Shoshonean site believed to be associated with a large pronghorn kill produced evidence of plant food and insect use. Especially noted were parts of seed cakes made of cracked *Amaranthus* seed. The cakes also contained parts of insects (Frison 1971b).

Many Middle and Late Plains Archaic sites on the Northwestern Plains are characterized by grinding stones and belowground food preparation pits (Mulloy 1954a, 1954b, 1965a; Mulloy and Steege 1967). These kinds of features and tools are usually regarded as diagnostic of the preparation of vegetable products for food. Large animal bones do occasionally appear in these food preparation pits and the grinding slabs may also have been used to reduce small-animal bones to a paste (Mulloy 1954a:59). The best interpretation at the present time is that a widespread dependence on plant food characterized much of prehistoric human life on the Northwestern Plains. There were long-term changes in emphasis on plant utilization throughout the Holocene as well as short-term changes corresponding to seasonal changes. There were also different emphases on plant collecting geographically, as determined by elevation, topography, soils, and precipitation.

Different approaches to the problem of hunters and gatherers are being tried. Flannery's (1968) concept of scheduling group movements to the availability of plant food has been of value but is limited by the fact that the basic studies of plant ecology are still in the early stages. What has been done indicates a surprising quantity of possible plant resources in the form of roots, bulbs, fruits, seeds, and greens.

The locations of many Archaic plant-gathering sites on the Northwestern Plains are predictable in relation to topography and soil types. Vegetative diversity was given as a main determinant of the location of Archaic sites in the lower Chaco River in New Mexico (Reher and Witter, 1977) and the same kind of working model is beginning to emerge as a useable one for much of the Northwestern Plains (see Galvan 1976). Soils, topography, and elevation are key determinants of vegetation, especially in areas where geological uplifting and faulting (as along mountain fronts) give rise to a wide variety of exposed strata that in turn affect soil types. Erosional remnants and river breaks are other areas of more intense Archaic occupation and these are also areas of diverse vegetation.

Not all human economic adaptations to areas of plant diversity can be attributed to the use of plant foods. Some animals are attracted to these areas only at certain times, whereas others make the areas their natural habitats. Topographic and vegetative diversity must have affected the hunting pattern as well as the plant gathering one.

The evidence presented throughout this book indicates that there have been a number of both long- and short-term climatic changes on the Northwestern Plains, and these have altered animal carrying capacity. Studies of present plant ecology are thereby limited in what they can reveal about past conditions, but they are nevertheless quite useful. For example, it is documented that the drought years of the 1930s caused the boundary of the short grass plains to move east for a considerable distance (Weaver 1968:146–194) and the conditions back in the original short grass plains were undoubtedly inferior in terms of animal carrying capacity. This was a drought of less than a decade's duration, but it was of sufficient intensity to seriously affect the economic activities of a hunting and gathering group.

There seems no reason to doubt that climatic changes of this nature, along with the more obvious changes such as took place during the Altithermal, occurred regularly throughout the Holocene (see, for example, Fritts 1965; Weakly 1950). We cannot, however, control the temporal aspects of archeological manifestations closely enough to determine what sort of ecological conditions were present during any given site manifestation. We do not know, for example, if the intense plant gathering that occurred in areas such as the Shoshone Basin or the Bighorn Basin was a short-term subsistence pattern associated with periods of low effective yearly precipitation or if it was a long-term pattern seasonally adapted to normal conditions. "Normal," of course, is based on what we consider good conditions at the present time.

The Medicine Lodge Creek site, mentioned several times throughout this book, is located at the base of the mountain slopes on the eastern side of the Bighorn Basin in Wyoming. It is a very extensive and complex site both geologically and archeologically. It extends for nearly 800 feet along the base of a steep bluff that in places is up to 40 feet high and forms an overhang of as much as 20 feet. The bluff faces the east and is close to a small mountain stream (Medicine Lodge Creek) that never freezes in the winter. Its location was advantageous for human and animal movements parallel to the mountains, and it gave access to the Bighorn Mountains. Also it is situated in or near a number of economic resource areas. These include (*a*) both live and ephemeral streams and their environs through deep canyons as well as open alluvial fans at the base of the mountains, (*b*) badlands of the interior Bighorn Basin, and (*c*) the western slopes of the Bighorn Mountains. A wide variety of ecological zones are included within these major landforms.

The site itself, because of unique conditions of preservation, has a number of undisturbed stratigraphic sections with an almost continuous record of human habitation back to about 10,000 B.C. In addition to this site, there are many other single and multiple component sites in the immediate area. In 1969, testing of the Medicine Lodge Creek site began and continued through 1971 when the indications were that it was a site of strong potential. At that time a multidisciplinary project was formed, the Medicine Lodge Creek Project, whose aims were to initiate research that would eventually reveal as much as possible of the archeology of the Bighorn Basin. Supported by two National Science Foundation grants, and additional aid from the University of Wyoming, the Wyoming Recreation Commission, and the Wyoming Archeological Society, the project, after three summers of intensive study, has resulted in the collection of a large body of data.

To date, the Medicine Lodge Creek site and other sites included within the project have produced over 40 radiocarbon dates from Clovis through the protohistoric period. There are, however, two noticeable gaps in the record. One is the Altithermal or Early Plains Archaic period, which is rapidly being clarified by the evidence from Mummy Cave (Husted and Edgar n.d.; Wedel *et al*. 1968) and several other sites (Laddie Creek, Southsider Cave, Paint Rock V, Granite Creek Rockshelter) mentioned in this book. The other gap is between Folsom, dated at about 10,700 years ago, and the first known occupation at Medicine Lodge Creek, at about 9700 years ago. The question of this gap shows no sign yet of being resolved within the Bighorn Basin but has been somewhat clarified in other areas (see Agenbroad 1973, 1974a, b; Agogino and Galloway 1965; Frison 1974b; Irwin-Williams *et al*. 1973). New evidence from the Agate Basin site (see p. 150) is also of importance for this time period.

The analysis of the results of the Medicine Lodge Creek Project investigations is in the early stages (Frison 1976a; Frison and Wilson 1975). However, through further study and continual reevaluation of the present data and problem-oriented collection and study of additional data, the prehistory of the Bighorn Basin will undoubtedly become better known. In conjunction with studies in the Bighorn Basin itself, intensive survey and testing of the Bighorn

Mountains are being conducted (Wilson 1973) and a better understanding of controversial prehistoric structures such as the Bighorn Medicine Wheel (Eddy 1974) is hoped for. We are also investigating the movements of prehistoric cultural groups back and forth from the low to high elevations. Similar projects in other parts of the Northwestern Plains should yield similar results. The Bighorn Basin is a unique area among many others that claim a similar distinction. All together they make up the entity known as the Northwestern Plains and the prehistory of each must be known and understood before the prehistory of the area as a whole can be known and understood.

Pecked and incised petroglyphs and painted pictographs cover many rock faces throughout the Northwestern Plains. At this time their recording, study, and analysis are not complete enough for anyone to formulate meaningful past cultural interpretations from them. We as yet have no sure methods that will give us absolute dates for these phenomena, so they could be a few hundred years old or a few thousand. Neither do we have the means with which to interpret their actual cultural meanings. When and if petroglyphs and pictographs provide a basis for meaningful past cultural interpretations, it will very likely stem partly from the work of specialists who can analyze and interpret changes in stylistic motifs. The time period involved and cultural meaning of a picture of an Indian on horseback carrying a gun is clear, but those of the pictographs and petroglyphs are a mystery (see Appendix 3).

With regard to the future, it appears that known and yet-to-be-discovered sites on the Northwestern Plains have the potential of providing many positive contributions to archeology, primarily in relation to prehistoric hunters and gatherers. More and improved animal population studies should reveal more of the seasonal structure of food procurement. This, along with other site evidence, should clarify the nature of communal procurement. There is, for example, some evidence accumulating to indicate at what stage in the animal procurement process the communality concept broke down and the group once more operated at the family level. At the Ruby site it appears that the construction and maintenance of the corral and the religious structure were communal, as were the collective driving and killing of the animals. However, the processing of the meat products was probably carried out at a number of contiguous but discrete locations by separate family groups. A complete study of the faunal remains in such processing areas may eventually tell us something of the distribution of animal carcasses. The institutional aspects of butchering and distribution of meat products are not known. We do know, however, that butchering a large number of animals is best accomplished as a cooperative effort.

The evolutionary history of the genus *Bison* and many other species during the Holocene is beginning to be clarified, but much of the data presented here are still hypothetical. The data base needs to be expanded through better controlled samples of prehistoric material and more intensive study of present-day bison and other animal herds. Paleo-climatic studies need to be intensified. The critical problem of Pleistocene extinctions (Martin 1967, 1973;

Martin and Wright 1967) is still an open question. The exact nature of human predation on past animal populations cannot be observed because of the extinction of much of the fauna involved as well as their natural predators. Along with this is a total change in the seasonal nature of present human predation and the technology involved. Population dynamics of animal populations need further study to examine the structure of animal populations and precisely what parts the human groups were exploiting. Studies along these lines will begin also to give more exact knowledge of actual caloric intake of the prehistoric human groups involved, which can result in better explanation and understanding of past economic systems.

The effects of the Altithermal period on human and animal populations are still largely conjectural; present hypotheses are based on inadequate data. Certain areas of the Northwestern Plains may serve as natural laboratories—especially intermontane basins where rapid changes in ecological conditions can be observed from low to high elevations, and shifts in these conditions due to climatic changes can be documented from the archeological record.

The problem of hypothetical mountain-oriented cultural groups during the Paleo-Indian and Early Plains Archaic periods is not yet satisfactorily resolved. Apparent ecological barriers to human movements were present at certain times at the foothill–plains borders. If these were actual barriers to human movements, the reasons are unclear; if they were not actual barriers, our data and interpretations are faulty. Whatever the answer, the problems are real and can only be resolved by the collection and analysis of more data and the application of a better research design.

In conclusion, the Northwestern Plains were not unchanging, dreary, and completely inhospitable to human habitation during the Holocene. They were characterized by great ecological diversity, to which prehistoric human populations were able to respond. These are not new ideas and have in fact been continually proposed for more than three decades (see Wedel 1941, 1953, 1963). Studies of human ecology on the Plains may be entering new and different phases but only because the necessary data base is becoming a reality.

There are no easy solutions to these problems. An ever-increasing number of innovative specialists will continue to apply new methods of interpretation. But present information indicates that hunting and gathering was the subsistence strategy that was the key to prehistoric survival on the Northwestern Plains, and that there were continual shifts of emphasis as the subsistence base changed in response to climatic conditions.

APPENDIX 1

Archeogeology of the Northwestern Plains

John P. Albanese

The multidisciplinary approach to archeological site excavation is standard procedure at most significant sites. One of the common auxiliary studies is geologic mapping carried out in conjunction with the excavation of the site. The main emphasis in this approach is the field analysis of paleotopography, stratigraphy, and sedimentation plus supplementary laboratory work.

Prior to 1976, 34 stratified Paleo-Indian sites in the Northwestern Plains were professionally excavated or tested—19 in Wyoming, 11 in Colorado, and 4 in Montana. Geologic field studies were carried out on 21 of these sites and geologic reports published on 11. I have not attempted to tabulate a similar record for younger sites in the area, though a cursory examination indicates a lesser number of geologic studies on younger sites.

Here I shall concentrate on the results of geologic field investigations carried out on a number of significant Archaic and Paleo-Indian sites excavated in Wyoming and elsewhere in the Northwestern Plains from about 1967 to 1977.

A synthesis of the geologic data gathered to date yields the following generalizations concerning archeological sites and Holocene geology on the Northwestern Plains:

1. The complete Holocene alluvial stratigraphic sequence on the Northwestern Plains is still poorly known. Only a few local stratigraphic studies are

available. With one exception (the Mazma Ash, a volcanic ash fall dated at 6600 years B.P. (Lemke *et al.* 1975:23) present in western Montana), it is still not possible to correlate Holocene units using a purely stratigraphic–lithologic approach. The occurrence of similar lithologies and faunas in units of different ages plus rapid facies changes within a given unit preclude making long-distance correlations using a purely lithologic or paleontologic approach. Haynes (1968) has taken a pragmatic approach to the problem and disregards the classical stratigraphic approach. He uses radiometric data to date a sedimentary unit and then fits the unit into an alluvial sequence. This "heretical" approach has also been advocated by Butzer (1974:143) for studies in middle Pleistocene stratigraphy: "The experience of several decades of unsatisfactory boundary definitions show that practicable stratigraphic boundaries must be tied to chronometric horizons despite established geological tradition favoring bio-, litho- or climostratigraphic markers or discontinuities [p. 143]."

These approaches are difficult for the "classical" stratigrapher to accept, as in his own mind he asks what is actually being correlated when someone correlates 3 feet of alluvium in the bottom of a New Mexico arroyo with 5 feet of fluvial deposits on a terrace in Montana, even though they both contain charcoal with the same radiocarbon age. The use of alluvial stratigraphy as a guide for dating on the Northwestern Plains can be summed up by this statement: "Give me the radiocarbon date or the name of a diagnostic projectile point contained within a given stratigraphic horizon and I will tell you the age of the stratigraphic horizon." Hopefully this situation will change as more data are acquired, but for the present and the foreseeable future it remains a fact of life.

2. At many site locales, particularly along drainages, there has been a marked change in topography since the site was utilized. At these sites, archeological interpretation based on the assumption that the past and present topography are the same would result in interpretive error.

3. Some types of site locales are more easily preserved than others. Consequently, an abundance of one type of site over another may reflect ease of geologic preservation rather than frequency of human use. This situation has a bearing on the study of regional settlement patterns.

4. Many Holocene terrace surfaces are erosional surfaces rather than depositional features. Archeological sites enclosed in sediments on a given terrace may vary considerably in age over short lateral distances. Likewise, Holocene terraces in different drainage basins may be of different ages even though their sequence and geomorphic appearance seem to be the same. Caution should be employed when using terrace sequences to date archeological sites.

I will discuss some of these generalizations in detail in the following sections.

PALEOTOPOGRAPHY

Most observers, when looking at an archeological site, have a tendency to assume that the present topography is essentially the same as that which existed at the time the site was used. In many cases the assumption is valid as in the case of a major bison jump or some overhangs. But in many other cases the topography changed with time, particularly along drainages, where drastic changes may occur in comparatively short periods of time.

Frison (1974b) points out the importance of understanding paleolandforms:

> A bone level high in the bank of an arroyo may represent a kill accomplished by driving animals into what was in Paleo-Indian times a trap formed by a knickpoint at the bottom of the arroyo. It might otherwise represent a jump over a terrace escarpment; or it might even be the remnant of a corral on what was at one time an advantageous location on a flood plain or terrace. All of these situations have been encountered in the archeological record and each would have required a different set of animal handling techniques during operation. The archeological interpretation of each is different, and proper identification of each feature is predicated on sophisticated geological expertise [p. 243].

A series of small-scale contour maps drawn at the top of the various stratigraphic horizons within a site are the main means for interpreting paleotopography. The maps can be prepared in the field using a transit or alidade; if the geologic data are properly programmed the maps can be drawn by use of the computer. The backhoe trenching machine is probably the most valuable field tool available to the geologist. Trenches peripheral to the site several hundred meters in length or more can be dug with the backhoe. These trenches are invaluable for examining a geologic profile. The changes in sedimentation relative to topographic position are also more easily observed. Questions (such as whether the site was located on the bank of a former braided stream) are more readily answered when the backhoe is employed.

Examples of topographic changes with time are given in Figure A1.1, which shows the present and former topography at two archeological sites. It is obvious that if the present topography were used as a model for interpreting cultural activity at these sites the archeological interpretation could be in error.

The Casper site, for example, is a Hell Gap bison kill. The butchered remains of an estimated 100 *Bison bison antiquus* were uncovered in the preserved remnant of a parabolic sand dune (Frison 1974b). The site is adjacent to the city of Casper, Wyoming. It is situated on a Pleistocene terrace 100 feet above the east-flowing North Platte River. It is on the western terminus of a 30-mile-long sand dune field along the north side of the North Platte River valley (Albanese 1974). The site was discovered in 1971 when earth-moving machinery scraped away the major portion of a stabilized sand dune while preparing a location for an industrial plant. When first viewed, the site appeared to contain a windrow of bison bone encased in 1–3 feet of unconsolidated eolian sand resting on the arkosic gravel cap of the Pleistocene terrace. At that stage of the investigation just how the bison bones were originally deposited was a puzzle. Detailed geologic mapping revealed three eolian sand units and a lacustrine unit. The unit containing the bison bone was in the shape of an elongate concave sand lens that filled a depression cut into an underlying sand unit (see Figure A1.2). The bone-bearing unit was capped by pond sediments. By analogy with the geologic setting in the adjacent modern sand dune field, it was postulated that the bones were originally contained in the bottom of the blowout portion of a parabolic sand dune and that a pond had formed in

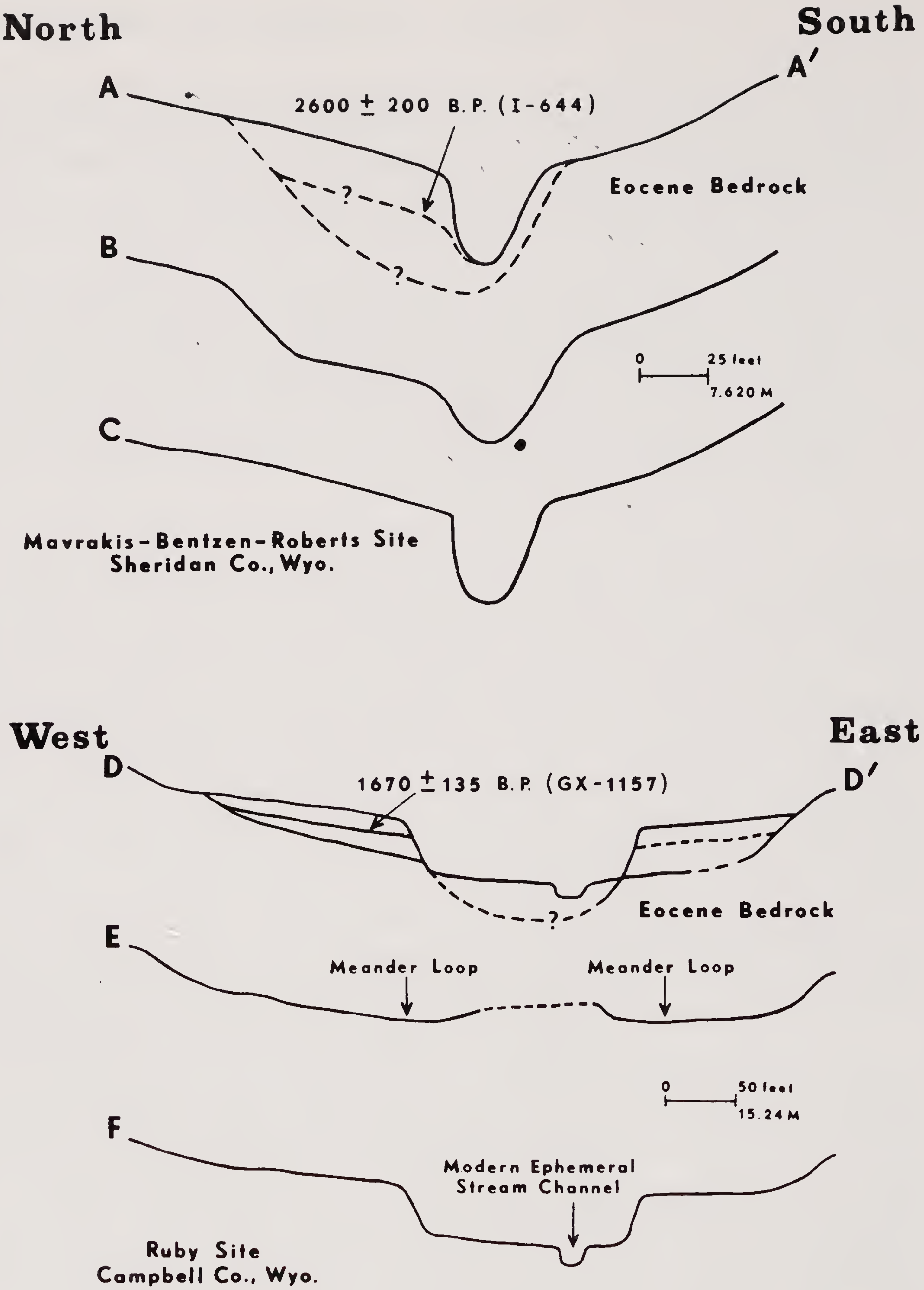


FIGURE A1.1. Topographic profiles and geologic cross-sections at two archeological sites in Wyoming that display change in topography during the Holocene. The stratigraphic units that contained the archeological material are labeled with their respective radiocarbon dates. Units other than bedrock are Holocene in age. Profile A is a geologic cross-section through the Mavrakis–Bentzen–Roberts site. Profile B shows the topographic configuration at the time the site was used as a bison kill station. Profile C shows the present topography. (Data are from Bentzen 1962 and my own field notes). Profile D is a geologic cross-section through the Ruby site. Profile E shows the configuration of the surface at the time the site was used as a bison pound (see Frison 1971a). The site occupied a low-relief meandering valley rather than the modern straight, arroyo-like valley (Albanese 1971). The modern topographic configuration is shown on profile F. The positions of these geologic cross-sections are shown in Figure A1.6.

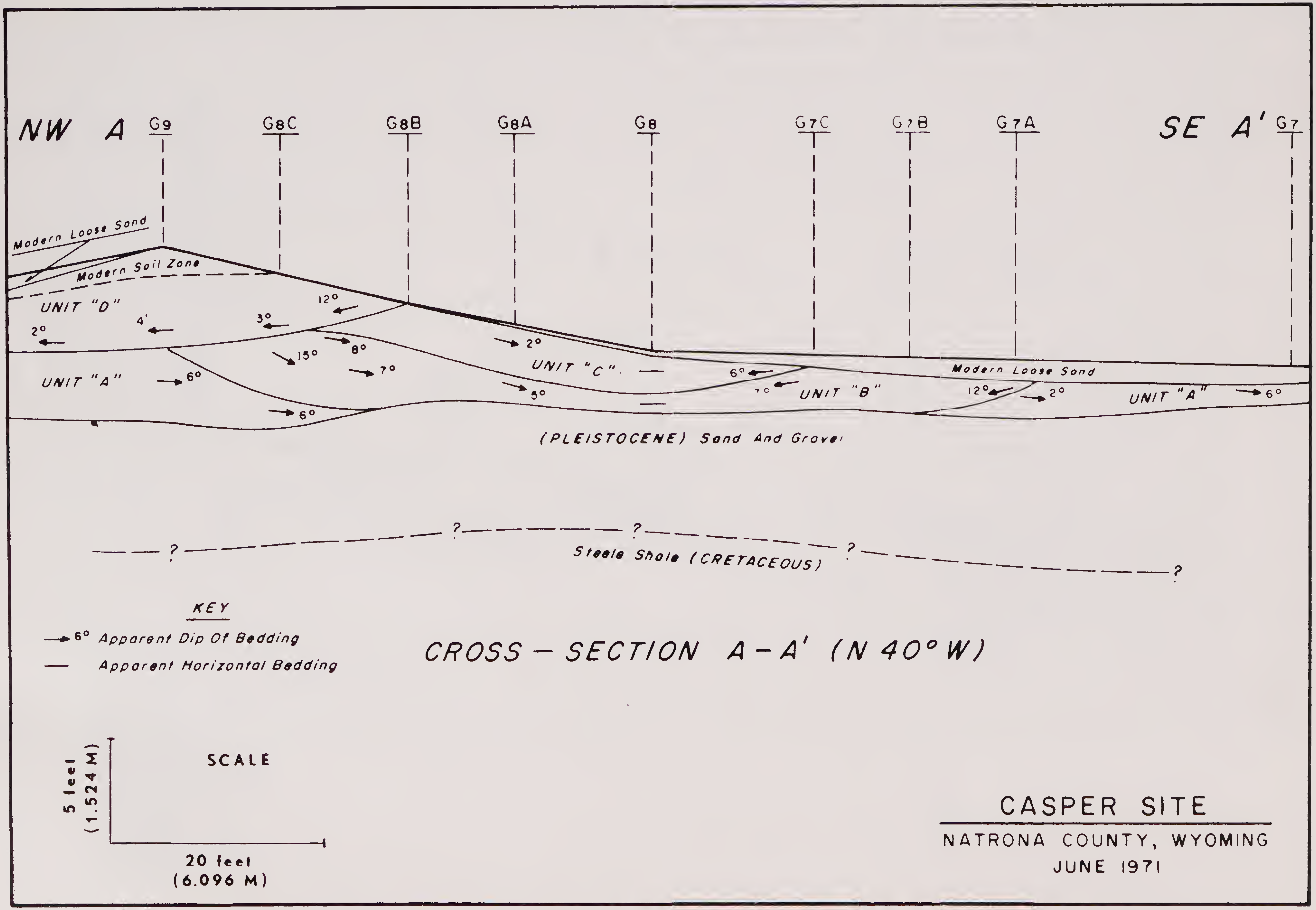


FIGURE A1.2. Geologic cross-section through the Casper site. Archeological material and bison bone were contained within Unit B. Unit C consists of pond sediments, which formed a seal and prevented the destruction of Unit B by deflation. Unit A is the oldest eolian unit at the site and the one into which the parabolic dune was formed; Unit D is the youngest eolian unit present.

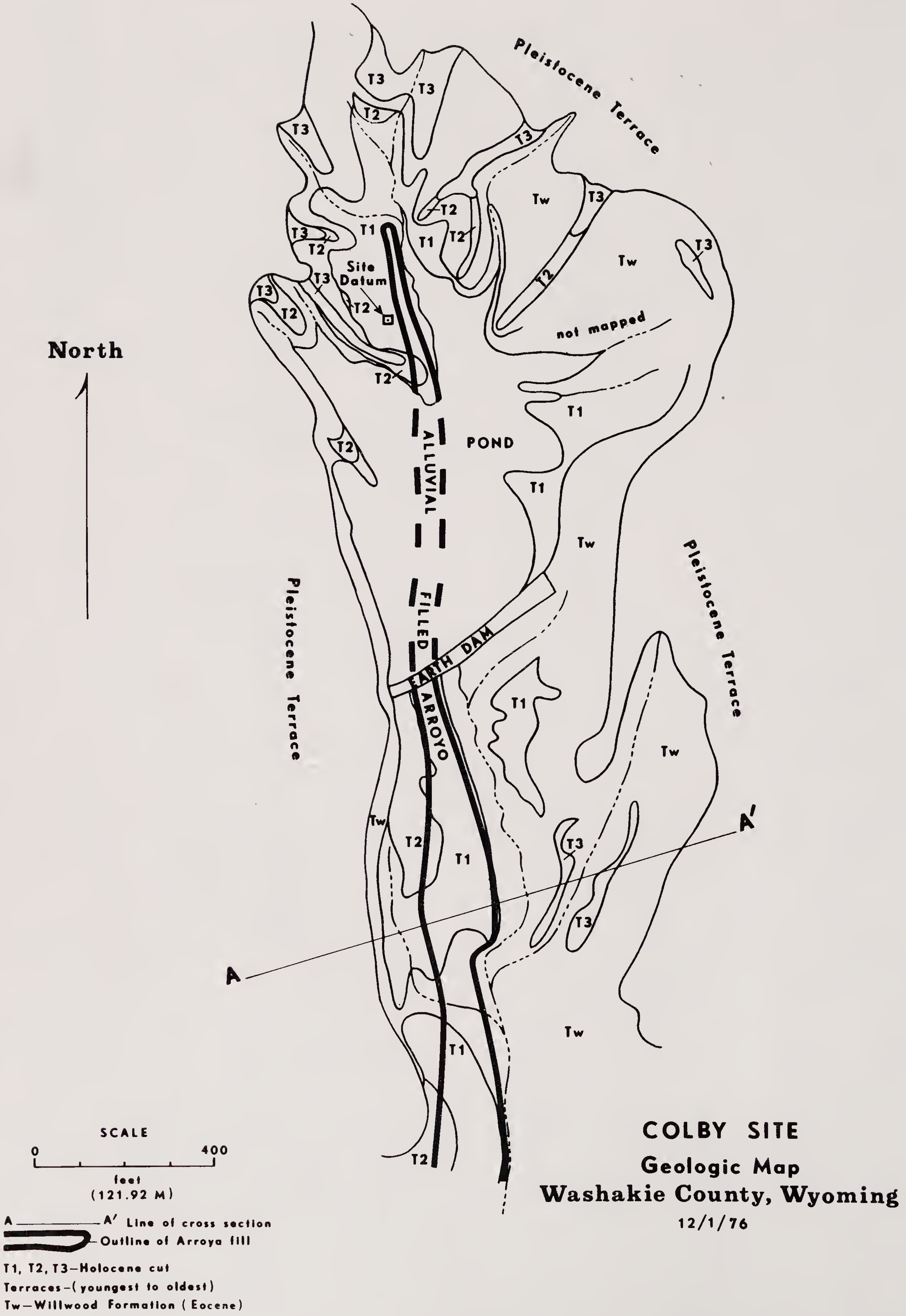


FIGURE A1.3. Geologic map of the Colby site area, Washakie County, Wyoming.

the blowout depression not too long after the bison had been butchered. The pond sediments formed a seal over the bone layer that prevented destruction of the site by wind deflation (Albanese 1974). There are modern examples of ponds in parabolic blowout depressions within several miles of the site. It was further postulated that if the original blowout was large enough to serve as a trap for a group of large animals, it probably was as large as many of the modern blowout depressions in the general area. Measurements of 48 blowout depressions in the general Casper area indicated a mean length of 1565 feet, a mean width of 445 feet, and a mean depth of 35 feet (Albanese 1974). The ancient blowout depression used as a kill station was probably as large or larger than the modern mean. For proper archeological interpretation at the Casper site, it was vital for the configuration of the original topographic surface to be known. The postulation of a former blowout depression served as a plausible hypothesis that strongly influenced the archeological interpretation.

Another example, the Colby site, is located in arid (8 inches of precipitation per year) badlands on the east flank of the Bighorn Basin, Wyoming. The site is at the head of a third-order ephemeral stream valley that trends north–south and drains to the south with an average gradient ratio of .315. The valley is approximately 3000 feet long. It is 600 feet wide and 25 feet deep at its northern end and approximately 700 feet wide and 40 feet deep at its southern end, where it flattens out and terminates 500 feet north of Slick Creek. The main modern stream course is straight, with a sinuosity ratio of 1.09. The Eocene Willwood Formation is bedrock in the area and is exposed at the surface all over the valley. Only a small amount of Holocene sediment is present within the channel of the modern stream. An earthen dam constructed across the stream has impounded flood and irrigation water. The resultant pond covers a portion of the site. Bone artifacts, four Clovis-style projectile points, and the disarticulated bones of seven mammoths have been recovered from six excavated areas strung out over a distance of 320 feet (see Chapter 3, p. 86). The archeological material and mammoth bones (radiocarbon dated at 11,200 B.P. ± 200) are contained within ephemeral stream sediments that consist of fine- to medium-grained, poorly sorted clayey, laminated to thinly bedded sands and some thin lag gravels composed of shale fragments and sandstone pebbles concentrated in elongate scour channels. Some of the mammoth bones were moved and redeposited downstream during episodes of flash flood. Evidence of undercutting and bank slump, which resulted in lateral bone displacement, is also present. Geologic mapping indicates that the alluvium-filled depression is in the bottom of a former arroyo that trended north–south and drained into Slick Creek, located half a mile south of the site. This former arroyo is adjacent to and parallels the modern master stream (see Figure A1.3). The site area lies at the head of this former arroyo. The preserved width of the arroyo in the site area is 40 feet and the thickness of arroyo fill increases from 0 to 10 feet in a southerly direction. The preserved width of the ancient arroyo 500 feet north of Slick Creek is approximately 200 feet; the maximum preserved thickness of alluvium is 17 feet. The sinuosity ratio of the former arroyo in the site area is 1.05 and its gradient ratio is .0333 (see Chapter 3, Figure 3.5).

These values are nearly identical to those for the adjacent modern ephemeral stream. Three Holocene erosional terraces (cut into Wilwood bedrock) plus a higher Pleistocene terrace rim the modern valley. The two lowest Holocene terrace surfaces truncate the arroyo-fill sediments that contain the archeological material. Thus the arroyo was filled with sediment prior to the creation of the second-highest Holocene terrace. The height of the original surface into which the arroyo was cut is unknown. If the arroyo was cut into the Pleistocene terrace surface, which seems the most plausible, the original arroyo in the portion that contains the mammoth bone was probably 25 to 30 feet deep. The ages of the Holocene terraces in the site area are not known. A very limited amount of information concerning Holocene terrace ages in the Bighorn Basin indicates that even though three Holocene terraces are present along most drainages, the ages of individual terraces can vary considerably between small drainage basins, even though these drainage basins are all tributaries of the Bighorn River (Albanese and Wilson 1974). The oldest Holocene terrace presently dated on the east flank of the Bighorn Basin contains a Folsom site (the Hanson site) 3 feet beneath the surface (see Chapter 4, p. 115). A Folsom fire hearth yielded a radiocarbon date of 10,700 B.P. ± 670. This terrace is the second terrace above a fourth-order ephemeral stream. Thus, it is possible that the highest Holocene terrace in the Colby site area existed at the time the arroyo formed. If so, and since the terrace has undoubtedly been modified, a minimum original arroyo depth of 14 feet in the southern portion of the excavated area would be indicated. In the Colby area the average terrace slope gradient ratio for the Pleistocene terrace is .031; for the highest Holocene terrace, .065. The gradient ratio for the ancient arroyo containing the mammoth bone is .033. The nearly identical gradient ratios for the Pleistocene terrace and the ancient arroyo plus the same directions of slope suggest that the ancient arroyo may have been cut into the Pleistocene terrace. In summary, it can be postulated that the arroyo containing the mammoth bone was originally two to four times as deep as it is at present, with the latter figure the more probable (see Figure A1.4).

If all the foregoing speculations and "hard" data are pieced together it can be postulated that at the time of the Clovis mammoth kills the site was at the head of a straight half-mile-long arroyo that drained to the south. It was probably 50 feet wide and 30 feet deep in the site area and 200 feet wide and 50 feet deep at its mouth. This model differs from the modern setting in that the ancient arroyo was markedly narrower than the present drainage valley. Apparently arroyos or channels were a favorite hunting and camping locale for Clovis peoples; half the 18 Clovis sites in the United States as listed by Haynes (1970) are within channels. Thus, the topographic setting postulated for the Colby site is not unique for Clovis sites.

The Jones–Miller site is a Hell Gap bison kill station that contained the disarticulated and butchered bones of approximately 300 bison (Stanford 1974). It is located in Yuma County, Colorado, on the west side of the valley of the northeast-flowing Arikaree River. The site is 3500 feet east of the river, atop a small, 26-foot-high topographic spur on the edge of the third highest river

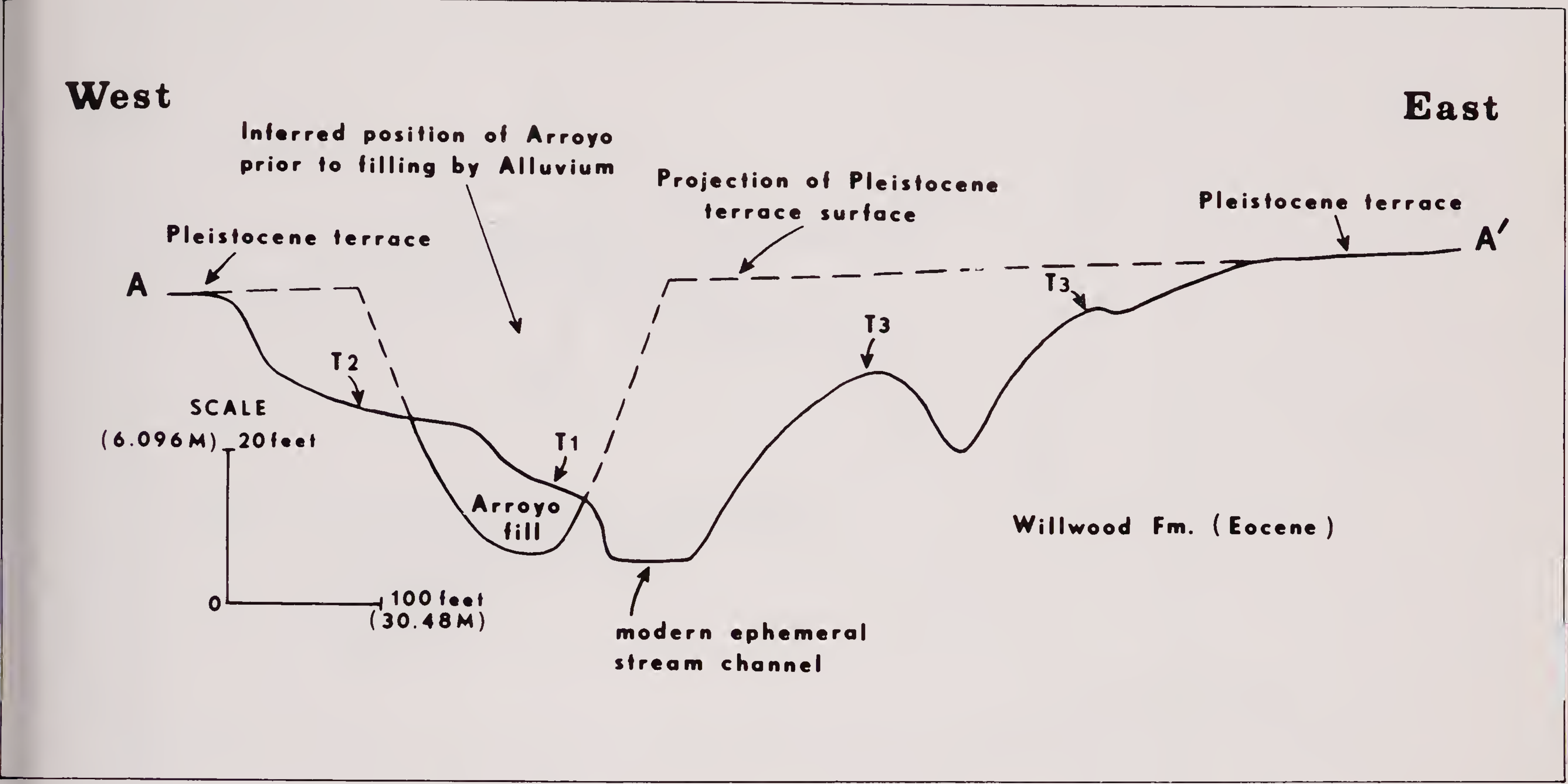

West
East
Inferred position of Arroyo prior to filling by Alluvium
Projection of Pleistocene terrace surface
Pleistocene terrace
Pleistocene terrace
A
A′
T3
T3
T2
T1
SCALE
(6.096M) 20feet
0
100 feet (30.48M)
Arroyo fill
Willwood Fm. (Eocene)
modern ephemeral stream channel

FIGURE A1.4. Geologic cross-section through Colby site area, Washakie County, Wyoming. This section is located 1200 feet downstream from the excavated portion of the site. The Holocene terraces cut into Eocene bedrock are labeled from youngest to oldest, T_1, T_2, and T_3. The sediment-filled arroyo is the same arroyo that contains the mammoth and Clovis artifacts to the north. The line of this cross section is shown on Figure A1.3. If the old arroyo was cut into the Pleistocene terrace surface, the projection of the arroyo outline indicates an approximate original depth of 40 feet and a width of 200 feet. If the arroyo was cut into the T_3 terrace surface, an approximate original depth of 24 feet and a width of 170 feet is indicated along this line of section.

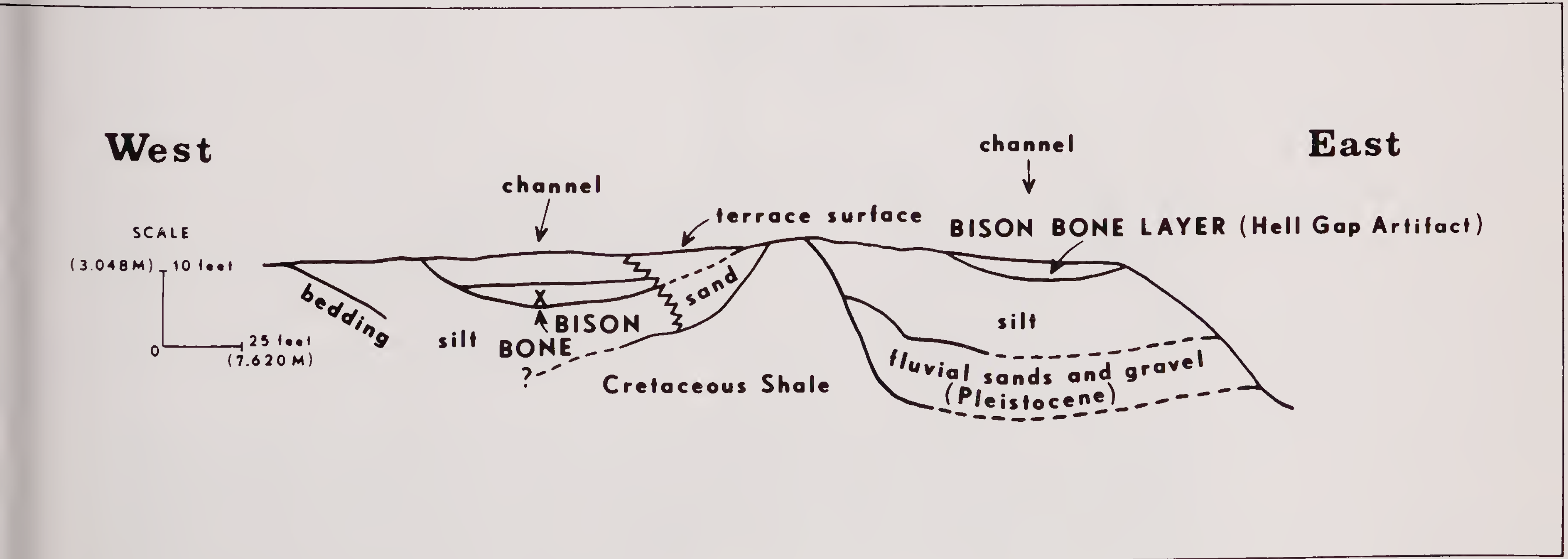


FIGURE A1.5. Geologic cross-section, Jones–Miller site, Yuma County, Colorado.

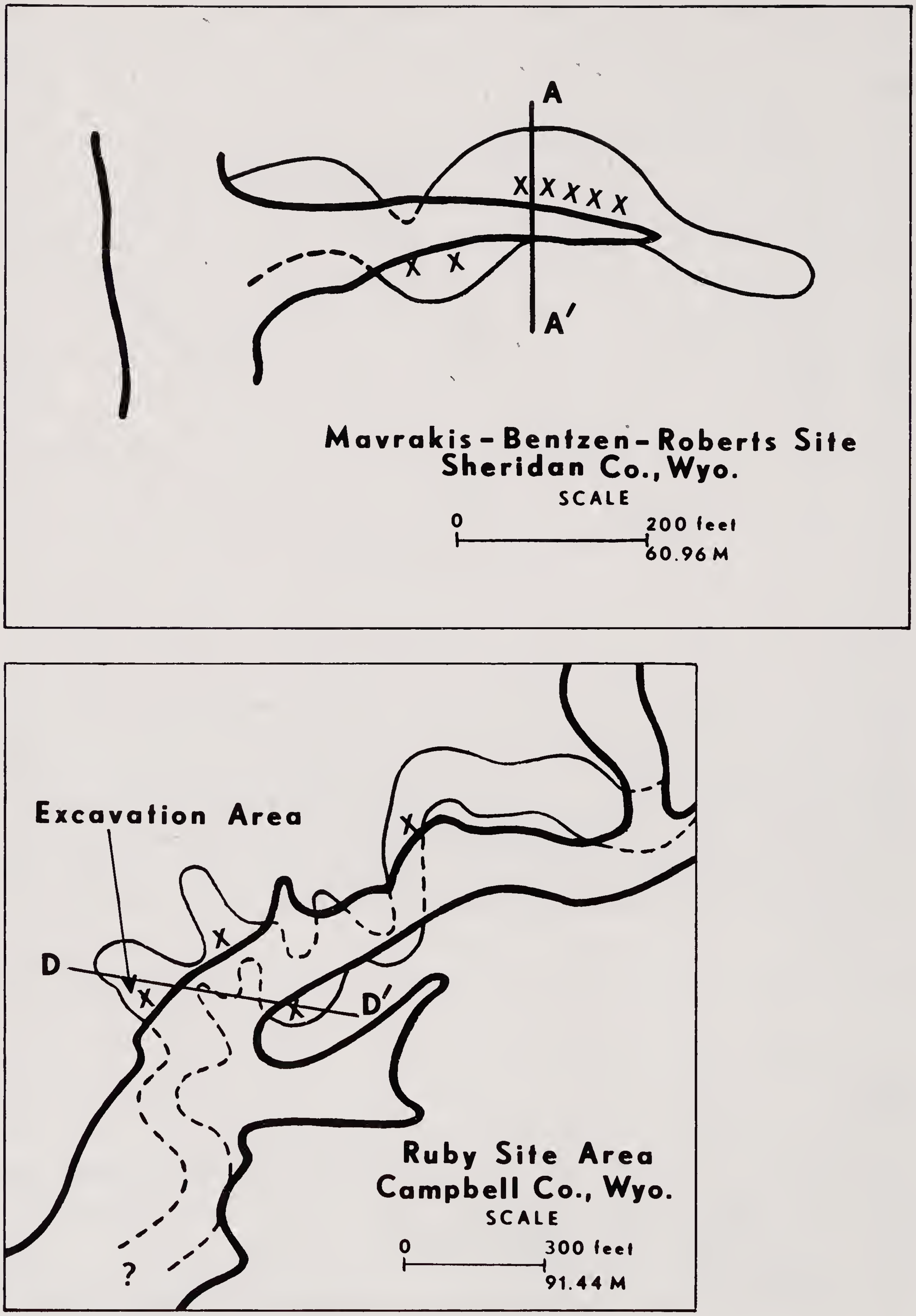


FIGURE A1.6. Geologic maps of Mavrakis–Bentzen–Roberts and Ruby sites. Heavy lines mark the outlines of present arroyo systems. Light lines show the position of drainages at the time the sites were occupied. The letter *X* marks outcrop exposure of the stratigraphic unit that contains the archeological material. Note the marked difference in sinuosity between the present and past drainages.

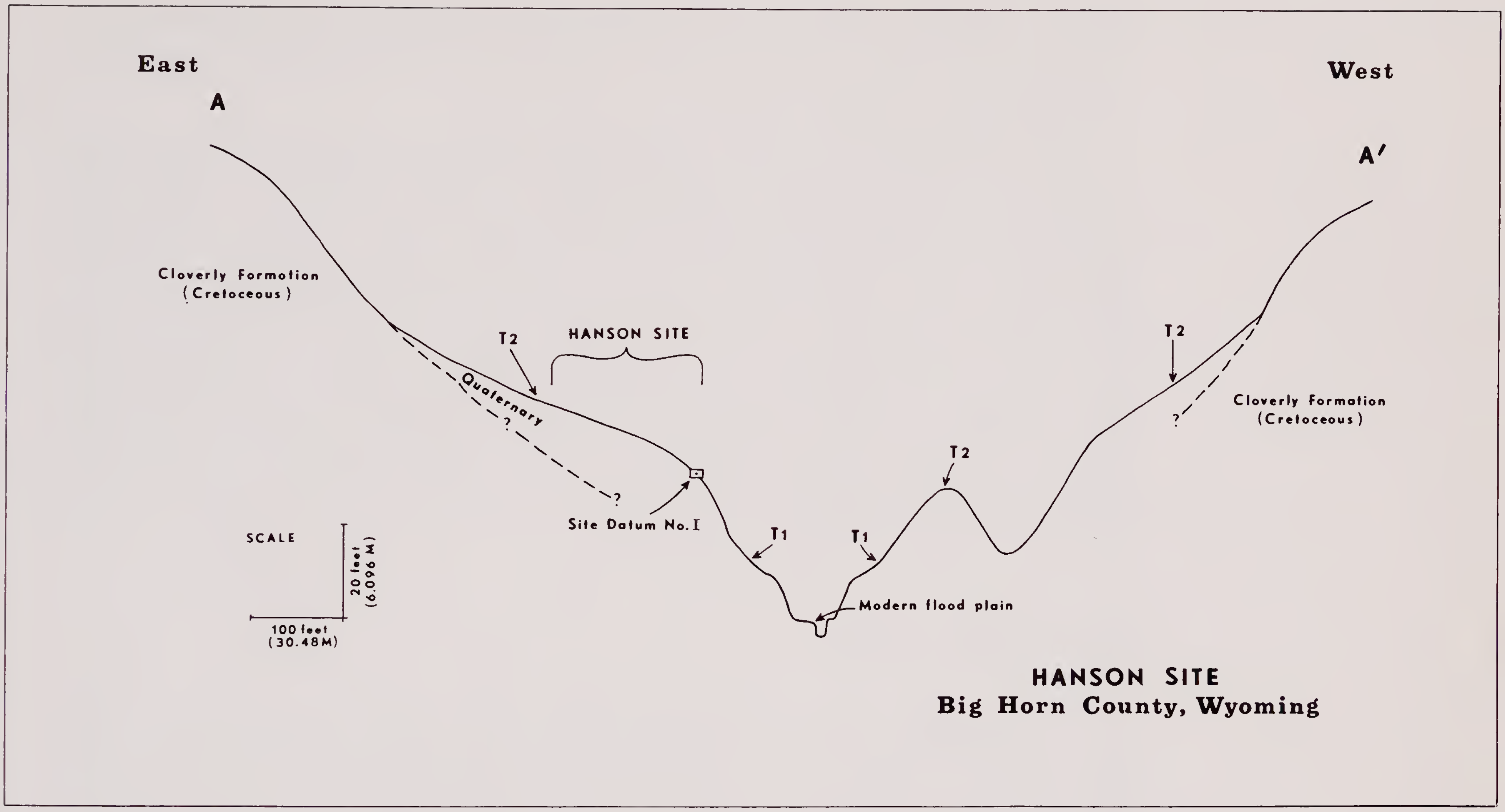


FIGURE A1.7. Cross section through Area I of the Hanson site. Symbols T_1 and T_2 indicate Holocene terraces. About 250 feet of lateral erosion and 40 feet of downcutting have taken place since the area was occupied by Folsom hunters.

terrace. There are six terraces present along the valley. When archeological excavation was first started at Jones–Miller in 1973, it was obvious that if the present topographic setting existed at the time of the Hell Gap occupation, the mechanics of just how the bison were trapped atop a small hill provided a serious interpretive problem. Geologic mapping of the excavated site plus the surrounding area revealed that the bison bone was concentrated in a 3-foot-deep swale that drained to the south. The preserved portion of the swale measured 70 × 95 feet. A portion of the site was destroyed by erosion. During the 1974 field season, a backhoe trench uncovered a minor amount of bison bone in a buried draw 75 feet west of the site area. Both draws are filled with thinly bedded colluvium composed of silt with some interlayered sand laminae and dispersed sand grains. The draws originally drained to the south into a fourth-order tributary of the Arikaree River [Albanese n.d. b]. The surface into which the first-order drainages were incised was at grade to the main channel of the Arikaree River and sloped 4° east. The main channel of the Arikaree was probably situated 1500 feet to the east of the site at the time it was utilized, approximately 10,000 years B.P. Since that time 3000–3500 feet of lateral planation and 40 feet of downcutting by the Arikaree River have taken place. If the site had been originally located on the banks of the Arikaree River rather than on a minor tributary it would have been destroyed. As it is, the site has barely escaped total destruction, as it lies only 30 feet west of the edge of the third terrace (see Figure A1.5).

The aforementioned sites are described in some detail because they are examples of dramatic change in topography with time. Figure A1.1 shows other examples of topographic change with time. The Ruby and Mavrakis–Bentzen–Roberts sites are today located along the sides of deep, straight-lined arroyos, whereas when used as bison traps they were located in broad, shallow draws drained by sinuous streams (see Figure A1.6). A similar situation existed at the Hanson site (Figure A1.7). At the time it was occupied by Folsom hunters (see Chapter 4, p. 115) it was situated adjacent to a stream (probably meandering) that drained a broad valley with a gentle sloping plane. The site is now situated on the second Holocene terrace, 40 feet above the modern ephemeral stream [Albanese n.d. a].

SITE PRESERVATION

The preservation of an archeological site depends primarily on the geomorphic setting of the site and its susceptibility to erosion. A camp, workshop, or quarry located on a sandstone cuesta, a drainage divide, or a high Pleistocene terrace may remain relatively undisturbed for thousands of years. A campsite located on the bank of a river may last only until the following spring flood when the bank is undercut and the site drops into the river. The preservation of bone is also dependent on the original geologic setting of the site. Fresh bone does not lie on the surface in an undisturbed state for very long. Voorhies (1969:28–31) found that the rate of bone destruction and dispersion by scavengers is relatively rapid. Voorhies also found that the rate of chemical destruction of bone is variable but large bone fragments, such as those of elephant, may withstand 10 to 20 years of weathering. Bone preservation requires rapid burial by sediment not too long after bone accumulation. Preservation further requires the pH of the enclosing sediment or soil to be such that the bone is not destroyed by leaching. It requires a unique combination of geologic circumstances to preserve sites such as Jones–Miller and Casper, where a large quantity of bone was left intact for 10,000 years.

The rarity of Paleo-Indian sites as compared to younger sites may be partially a function of geologic destruction with time. As previously mentioned, 30 Paleo-Indian sites were professionally tested or excavated in the states of Colorado and Wyoming prior to 1976. These 30 sites can be grouped into five geomorphic categories:

1. Overhangs (rockshelters)	6
2. Sites in sand dune fields	4
3. Arroyo sites	4
4. Stream and river terrace sites	10
5. Open sites, usually located near a spring, pond or lake	6

The sample is small and nonrandom in geographic distribution—for example, all the rockshelter sites are in or adjacent to the Bighorn Basin of Wyoming. The distribution of these sites is dependent on past human cultural activity and the vagaries of geologic preservation. The fact that more rockshelter sites have been reported than arroyo sites or sites in sand dunes does not necessarily mean that rockshelters were preferred places for human activity. Sites in sand dunes are easily destroyed by deflation, and arroyos are subject to erosion and flooding during periods of high rainfall. Rockshelters are fairly permanent structures, not as prone to destruction as sand dunes or arroyos. The terrace category includes 10 sites, 4 of which are located on the Kersey terrace—a Pleistocene terrace bordering the valley of the South Platte River, the main drainage in northeastern Colorado. Five terrace sites are located on minor drainages of a fourth order or less (on a map scale of 1:20,000). Not one Paleo-Indian site has been reported to date on a Holocene terrace on either the South Platte River of Colorado or the North Platte River of Wyoming (the major drainage in eastern Wyoming). Wedel (1963) points out the attractiveness of river bottoms to historic Plains Indians as winter camping locales; it is not likely that river valleys were shunned by prehorse Indians. At Casper, during about the past 4500 years, the North Platte River has cut a swath 7000 feet wide and 30 feet deep through older Quaternary sediments (Albanese and Wilson 1974). Consequently, any archeological sites within the eroded sediments have been destroyed. Thus the apparent lack of Paleo-Indian sites on Holocene terraces of the North Platte River may be due to the removal of many of them by river erosion.

Whether the small sample of Paleo-Indian sites in Colorado and Wyoming represents the original distribution and preference for site locales by Paleo-Indians or merely the accidents of geologic preservation is not readily answerable. However, any analysis of Paleo-Indian settlement patterns or activities in the Northwestern Plains should take into account the probability that the present data are biased because of the selective preservation of sites.

Another facet of the site distribution problem is the concealment of sites due to burial by sediment. Recent geological investigations in Wyoming carried out in conjunction with archeological surveys covering large areas point to a close relationship between geomorphology, sedimentation, and site distribution. One such survey covered a 100-square-mile area west of Boysen Reservoir in central Wyoming. Ninety-two archeological sites were located on the survey. Sites were clustered in areas where erosion is active and slope angles vary from 2 to 30°. In most areas of low slope angle (1° or less), Holocene slope wash sediments cover the surface and are currently being deposited [Albanese n.d.c]. Archeological sites are absent at the surface in the areas of Holocene slope wash deposition (approximately 40% of the total area), except in those areas where roads have been bulldozed through the slope wash. Several hundred fire hearths were uncovered in road cuts in one such area. Without ground disturbance by man, these fire hearths would have remained buried and undetected. The visibility of archeological sites in the Boysen area is directly related to geologic as well as cultural factors. This situation may have something to tell us about the conclusions that are drawn from some archeological surveys.

HOLOCENE TERRACES

By common usage, the term *terrace* refers to those remnants of former valley floors that are elevated above the modern floodplain. The terrace has the form of a step and can be capped by the alluvial deposits of the former valley or it can be cut into bedrock. The alluvial deposits associated with a terrace are often considered to have been deposited "as a single stratigraphic unit. This implies that the mass of material was deposited during a more or less uninterrupted period of aggradation [Leopold and Miller 1954:4]." Terraces are of interest to archeologists, as archeological sites are commonly found on terrace surfaces or within terrace sediments. Attempts have been made in the past to use terraces for relative dating of archeological sites (Hughes 1950).

Holocene terraces have been identified and correlated over parts of Wyoming and Colorado. A system of three Holocene terraces has been described within the Powder River, Bighorn, and Wind River drainage basins of Wyoming (Leopold and Miller 1954), the Denver area of Colorado (Scott 1965), and the Arikaree Valley of eastern Colorado and Kansas [Albanese (n.d.) b]. A two-terrace Holocene system along the North Platte River of Wyoming has been described by Leopold and Miller (1954). In the past, terraces and their associated sediments have been used as time-equivalent units and correlated over large areas (Leopold and Miller 1954). Much of this early correlation work

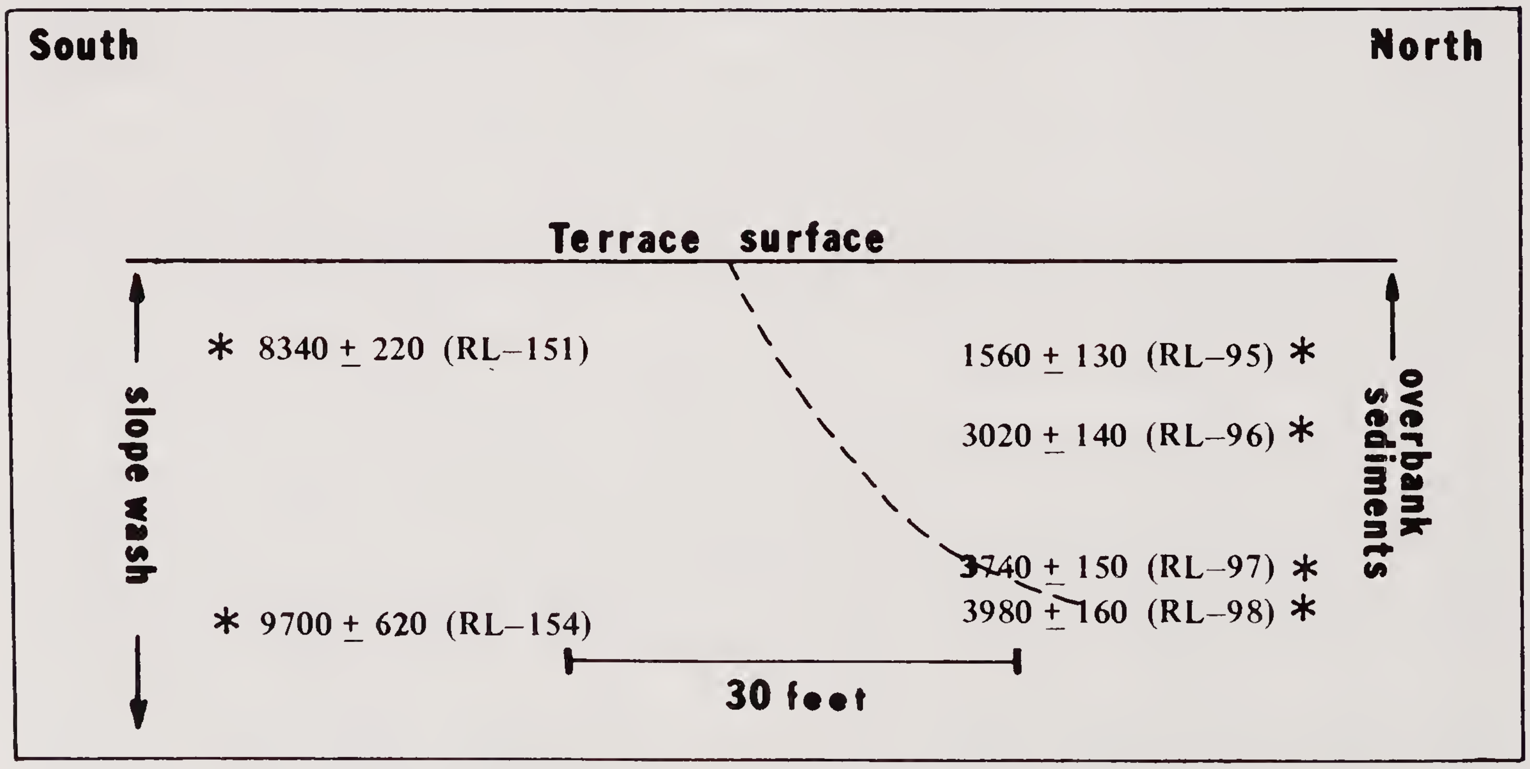


FIGURE A1.8. Diagrammatic cross-section of deposits along the west bank of Medicine Lodge Creek site, near Hyattville, Wyoming. Asterisks show sample proveniences, and a marked lateral discontinuity is clear.

was done without the benefit of radiocarbon dates. Since the 1960s, it has become apparent that in many cases Holocene terraces and terrace alluvium are not time-equivalent over large areas and sometimes not even within a local drainage basin. Hydraulic regimes and rates of sedimentation may differ markedly within small drainage basins or even along an individual stream (Hadley and Schumm 1961). The number of Holocene terraces may vary in different-order drainages that drain into the same major river (Albanese and Wilson 1974:16). Radiocarbon dates from archeological sites in Wyoming indicate that many alluvial terrace surfaces are actually erosional planes rather than depositional surfaces. Stratigraphic units lying within 50 horizontal feet of each other may differ in age by 5700 years and yet be truncated by the same terrace surface (Albanese and Wilson 1974) (see Figure A1.8.).

The point of this discussion is that one cannot assume *stratified* sites located on the same terrace to be of the same age, or sediments on equivalently spaced terraces in different areas to be of the same age. It is possible to have a stratified Paleo-Indian site located adjacent to a stratified Woodland site, within ''alluvial fill'' on the same terrace remnant.

APPENDIX 2

Mammoths (*Mammuthus*) from the Colby Site

Cary T. Madden

Remains of mammoths, genus *Mammuthus,* Burnett 1830, were collected from the late Pleistocene Colby site, Wyoming and radiocarbon dated at 11,200 B.P. The mammoth remains include the dentitions of four individuals and the postcranials of at least six individuals, as evidenced by the presence of six right scapula in the collection (see Chapter 3, page 86). I shall describe the dentitions rather than the postcranials because dentitions are far more diagnostic and it is therefore upon such remains that the identifications and diagnoses of extinct and extant elephants have been, and are still, based.

The mammoth dentitions from the Colby site represent an early middle-aged adult, a late juvenile, a young adult, and an older adult. The dental remains of the early middle-aged adult and the late juvenile are complete enough to be identified as *Mammuthus (Parelephas) columbi*; those of the young adult are complete enough to be identified provisionally (cf.) as *M. (P.) columbi*; and those of the older adult are complete enough to be identified only as *Mammuthus (Parelephas)* sp. indet.

Four species of mammoths are known from the late Pleistocene (Rancholabrean Land Mammal Age) and/or early Holocene of North America: *Mammuthus (Mammuthus) primigenius* (Blumenbach) 1803, the woolly mammoths; *Mammuthus (Parelephas) jeffersoni* (Osborn) 1922, the Jeffersonian mammoths; *M. (P.) exilis* (Stock and Furlong) 1928, the dwarf mammoths;

and *M. (P.) columbi* (Falconer) 1857, the Columbian mammoths (Madden n.d.). *M. (M.) primigenius* is known from Alaska to the Northeastern United States (Osborn 1922, 1924; Hay, 1923). *M. (P.) jeffersoni* is known from Saskatchewan and Ontario to Texas, and from California to Virginia (Madden n.d.). *M. (P.) exilis* is known only from the Santa Barbara Channel Islands of Southern California (Madden 1977; see also Stock 1935). *M. (P.) columbi,* present at the Colby Site, was the characteristic elephant in North America during most of the Quaternary. This species ranges from the middle Pleistocene to at least the late Pleistocene (late Irvingtonian and Rancholabrean land mammal ages; Kansan through Wisconsinian glacials), and is ancestral to both *M. (P.) exilis* and *M. (P.) jeffersoni* (Madden n.d.).

MAMMUTHUS (PARELEPHAS) COLUMBI (Falconer) 1857

The early middle-aged adult is represented by a skull and an associated mandible. The skull (see Chapter 3, Figure 3.6) possesses tusks, second molars, and partially erupted third molars (Figure A2.1). The mandible possesses second and third molars.

The tusks (I^2's) are long and strongly down and inwardly turned, as is typical of all well known species of the genus *Mammuthus* (Maglio 1973). The left I^2, the better preserved of the pair, is 125-mm wide at the front of its sheath. The height is unavailable at present because the dorsal aspect of the tusk is protected and supported by a plaster jacket. The incisor is about 130-mm high.

The left M^2 (Figure A2.1), which is slightly better preserved than its right counterpart, is nearly complete; it lacks probably only its front plate. The tooth has 11 plates and an average enamel thickness of 2 mm. It is 169-mm long and 96-mm wide (at the seventh plate from its rear). The plate frequency (number of plates per 100 mm of length) is 6.8. Originally, the tooth was approximately 186-mm long and is estimated to have had 12 plates. The estimated plate number, X, is X/186 mm = 11/169 mm (186 mm is the approximate; 169 mm the present length of the tooth; and 11 the present number of tooth plates). Measurements for the enamel thicknesses (from front to back) are 2.4; 2.4; 1.7; 1.7; 2.2; 2.2; and 1.4 (all in millimeters).

The dimensions and plate frequencies of M^2 are within the observed ranges of variation for dimensions and plate frequencies of M^2 in *Mammuthus (Parelephas) columbi* (Falconer) 1857 and indicate that the individual represented is a memeber of that species (see Table A2.1).

The upper third molars are, as mentioned, only partially erupted (as evidenced by the presence of 3 barely worn plates on the right M^3) and as a result little can be stated at present about them. The right tooth (Figure A2.1), the better preserved of the two, has a length greater than 180 mm, a width of at least 69 mm (at the sixth ridge from the front), and a height greater than 177 mm. The tooth appears to have 12 or 13 plates exposed.

The lower second molars are only partially complete, each having shed at least 2 or 3 plates and their front supporting roots. The right M_2 is 141 mm-long

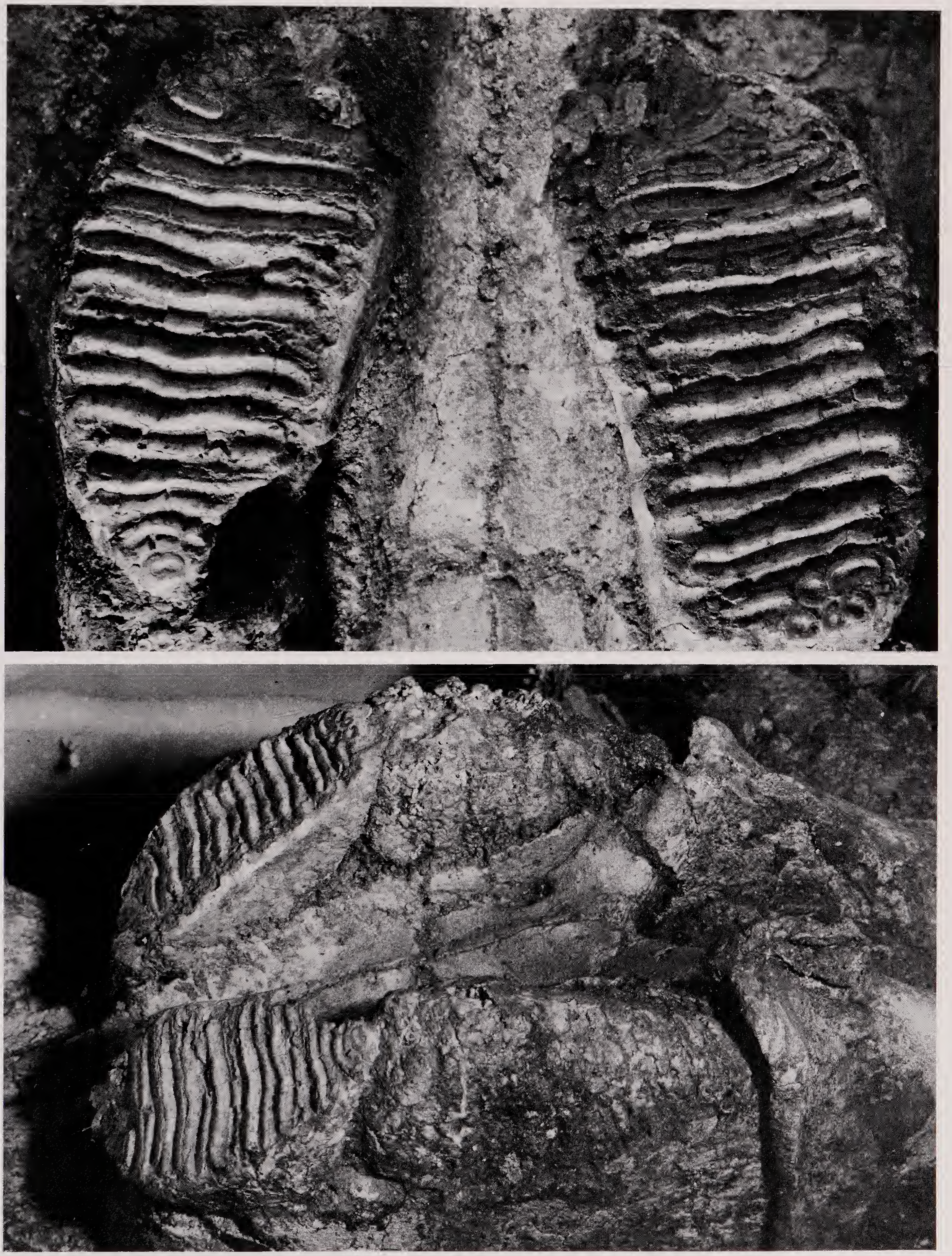


FIGURE A2.1. Upper 2nd molar teeth from the early middle-aged adult mammoth at the Colby site. Anterior direction is toward the top (a); partially-erupted upper 3rd molars and the same upper 2nd molars. Anterior direction is toward the left (b).

TABLE A2.1
Dimensions (in Millimeters) and Plate Frequency of M^2 in the Middle-aged Adult and in *Mammuthus (Parelephas) columbi; M (P.) exilis; M. (P.) jeffersoni;* and *M. (M.) primigenius*[a]

	Colby	*M. columbi*	*M. exalis*	*M. jeffersoni*	*M. primigenius*
P $\bar{x}$	>11 (est. 12)	12.6	12.5		15.75
Or		11–16	12–13		15–17
N	1	8	6		12
Sd		1.7	.55		.62
L $\bar{x}$	>169 (est. 186)	200	143.71		167.73
Or		177–229	123–181		151–202
N	1	11	7		12
Sd		19	15.15		
W $\bar{x}$	96	85	60.18	C 94	72.72
Or		70–101	50–70		64–80
N	1	15	11		12
Sd		9	6.43		
Et $\bar{x}$	2	2.11	1.81		1.3
Or		1.6–2.7	1.35–2.27		1–1.3
N	1	9	11		7
Sd		.37	.35		0.1
Pf $\bar{x}$	6.8	6.61	9.2	9.45	10.22
Or		5.2–8.57	7.33–11.5	8.9–10	9–11.5
N	1	16	11	2	14
Sd		1.01	1.37		

Abbreviations: **P**: Number of Plates; **L**: Maximum length; **W**: Maximum width; **Et**: Mean enamel thickness; **Pf**: Plate frequency (Number of plates per 100 mm); $\bar{x}$: Arithmetic mean; *Or*: Observed range; *N*: Sample size; *Sd*: Standard deviation.

[a] Data for this species mainly from Maglio (1973:61).

and 86-mm wide (at the sixth ridge from its rear) and has 9 plates, an average enamel thickness of 1.66 mm, and a plate frequency of 6.5. If the length approximated the estimated length of its upper counterpart (181), the M_2 would have had 12 plates as did the upper tooth. The dimensions for the enamel thicknesses are 1.4; 2.2; 1.5; 1.3; 1.4; 2.2; and 1.6, all in millimeters. The dimensions and plate frequency of the tooth are, as to be expected, within the ranges for those of M_2 in *M. (P.) columbi (Table A2.2).*

Both lower third molars are only partially erupted, the right tooth showing that its front three plates were used in occlusion. This condition is identical to that of the right M^3 and confirms that both the mandible and skull represent the same individual. Ten plates of the left M_3 are exposed. The erupted portions of both third molars are weathered and broken (Figure A2.2).

The mandible is short and has short, wide, and high horizontal rami and short and high vertical rami. The mandible is about 508 mm long, though it was slightly longer in life, for the front part of its spout is absent. The width of the right horizontal ramus is 142 mm; the height of the left is 127 mm. The short length of the mandible is due only in small part to the age of the individual represented. Short mandibles with short, wide, and high horizontal rami and short and high vertical rami are characteristic of progressive species of *Mammuthus,* such as *M. columbi, M. jeffersoni,* and *M. primigenius.*

The present specimen represents an early middle-aged adult because its second molars were fully used in occlusion. A specimen represents an old adult if only its third and last molars were used in occlusion. Individuals of modern local populations of *Loxodonta africana* (Blumenbach) 1797, for example, are adult or sexually mature at the time their first molars are used in occlusion (Laws 1966); females of local populations of *L. africana* are on the average sexually mature at about 20 years of age (Laws 1969). The Colby early middle-aged adult is approximately 31 years old, for its M_2's were fully used in occlusion and were undergoing anterior erosion, and its M_3's were hardly used in chewing, being barely worn only on their front three plates. These conditions are intermediate between those of age groups XVIII and XIX of Laws (1966, Figure 5) between 30 and 32 years old (Laws 1976 personal communication).

TABLE A2.2
Dimensions (in Millimeters) and Plate Frequency of M_2 in the Colby Middle-aged Adult and in *Mammuthus (Parelephas) columbi; M. (P.) exilis; M. (P.) jeffersoni;* and *M. (M.) primigenius*[a]

	Colby	*M. columbi*	*M. exilis*	*M. jeffersoni*	*M. primigenius*
P $\bar{x}$	>9 (est. 12)	19.92	11.62		14.5
Or		11–16	10–13		13–16
N	1	13	8		10
Sd		1.8	.92		.88
L $\bar{x}$	>141 (est. 181)	207.18	149.67		173.06
Or		180–231	131–187		147–185
N	1	11	9		8
Sd		16.75	16.35		
W $\bar{x}$	86	77.88	58	78	67.38
Or		65–90	49–67	70–86	43.85
N	1	17	18	2	13
Sd		7.58	4.81		
Et $\bar{x}$	1.66	2.31	2.2		1.38
Or		1.2–3.25	1.66–2.78		1–2
N	1	7	19		9
Sd		.71	.36		
Pf $\bar{x}$	6.5	6.46	7.84	7	8.92
Or		4.3–9.3	6.17–10.2	6–8	7–11.4
N	1	21	19	2	13
Sd		1.23	1.14		

Abbreviations: **P**: Number of Plates; **L**: Maximum length; **W**: Maximum width; **Et**: Mean enamel thickness; **Pf**: Plate frequency (number of plates per 100 mm); $\bar{x}$: Arithmetic mean; *Or*: Observed range; *N*: Sample size; *Sd*: Standard deviation.

[a] Data for this species mainly from Maglio (1973:61).

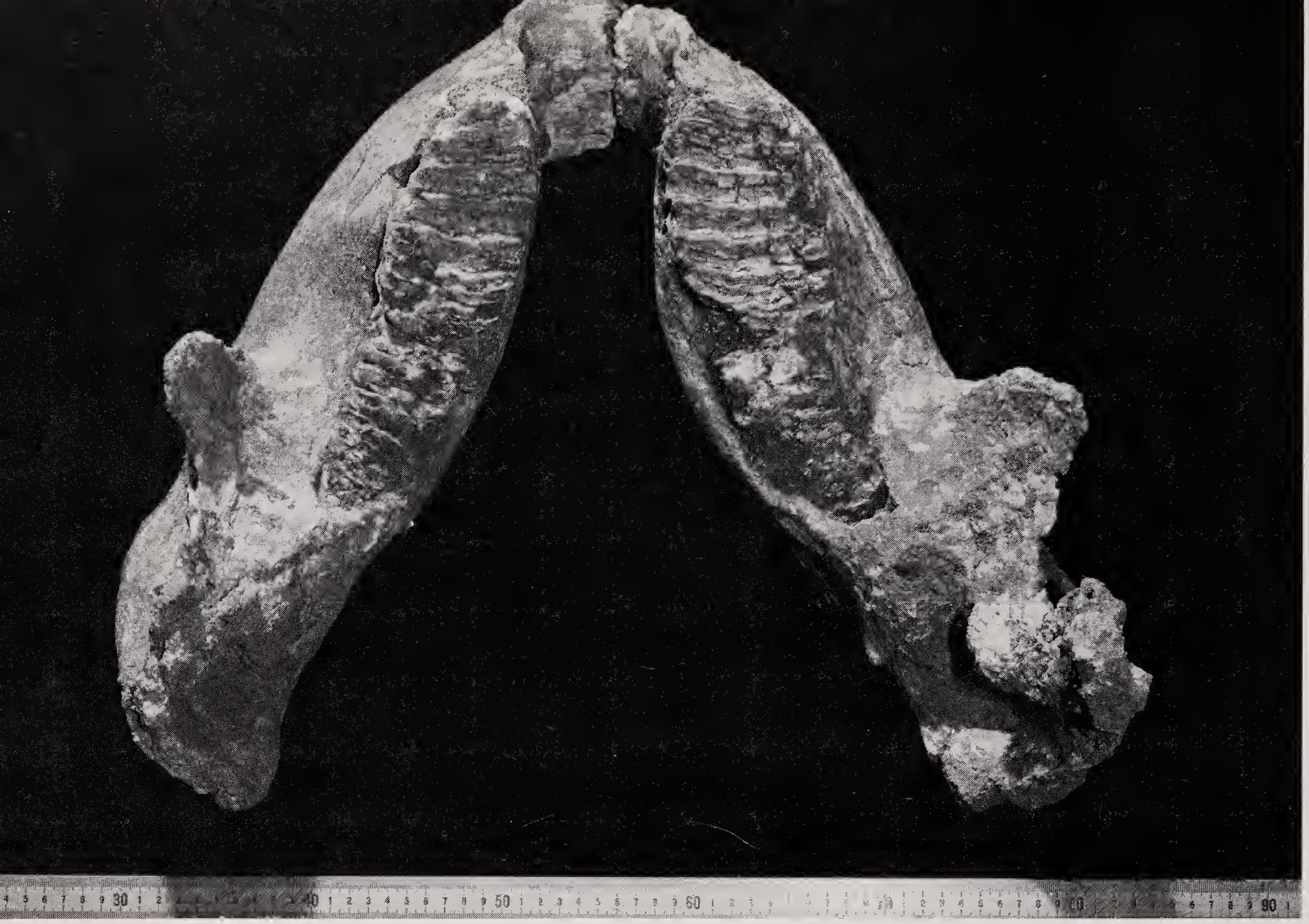


FIGURE A2.2. Mandible with erupted lower 2nd molars and partially-erupted lower 3rd molars from the early middle-aged adult mammoth from the Colby site.

The late juvenile remains identified as *M. (P.) columbi* are represented by a skull and articulated mandible (see Chapter 3, Figure 3.8). The skull possesses tusks, and both the skull and mandible possess first molars, which are fully erupted and were used in occlusion. The skull also possesses second molars that were fully erupted beyond the gum but were not used in occlusion (Figure A2.3). The second molars of the mandible are unerupted. The tusks appear complete, but are protected and supported by plaster jackets. The left tusk is 55 mm wide and 59 mm high.

The right M^1 appears complete, though it is especially heavily worn anteriorly, where the front 2 plates are obliterated. The tooth has 11 plates (10 complete in a 105 mm line), an average enamel thickness of 1.7 mm, and a plate frequency of 9.5. It is 140-mm long and 62-mm wide (at the eighth ridge from its rear). Since the tooth has 10 complete plates in a 105-mm length and is 140-mm long, it must have had 13 plates originally. The measurements and plate frequency of M^1 are within the ranges for the same tooth in *M. (P.) columbi* (Table A2.3). Thus, the late juvenile represents that taxon, like the early middle-aged adult described previously.

The right M^2 has 15 plates (or 14 plates and a large anterior talon), is 224-mm long, and has a plate frequency of 7. The number of plates, length,

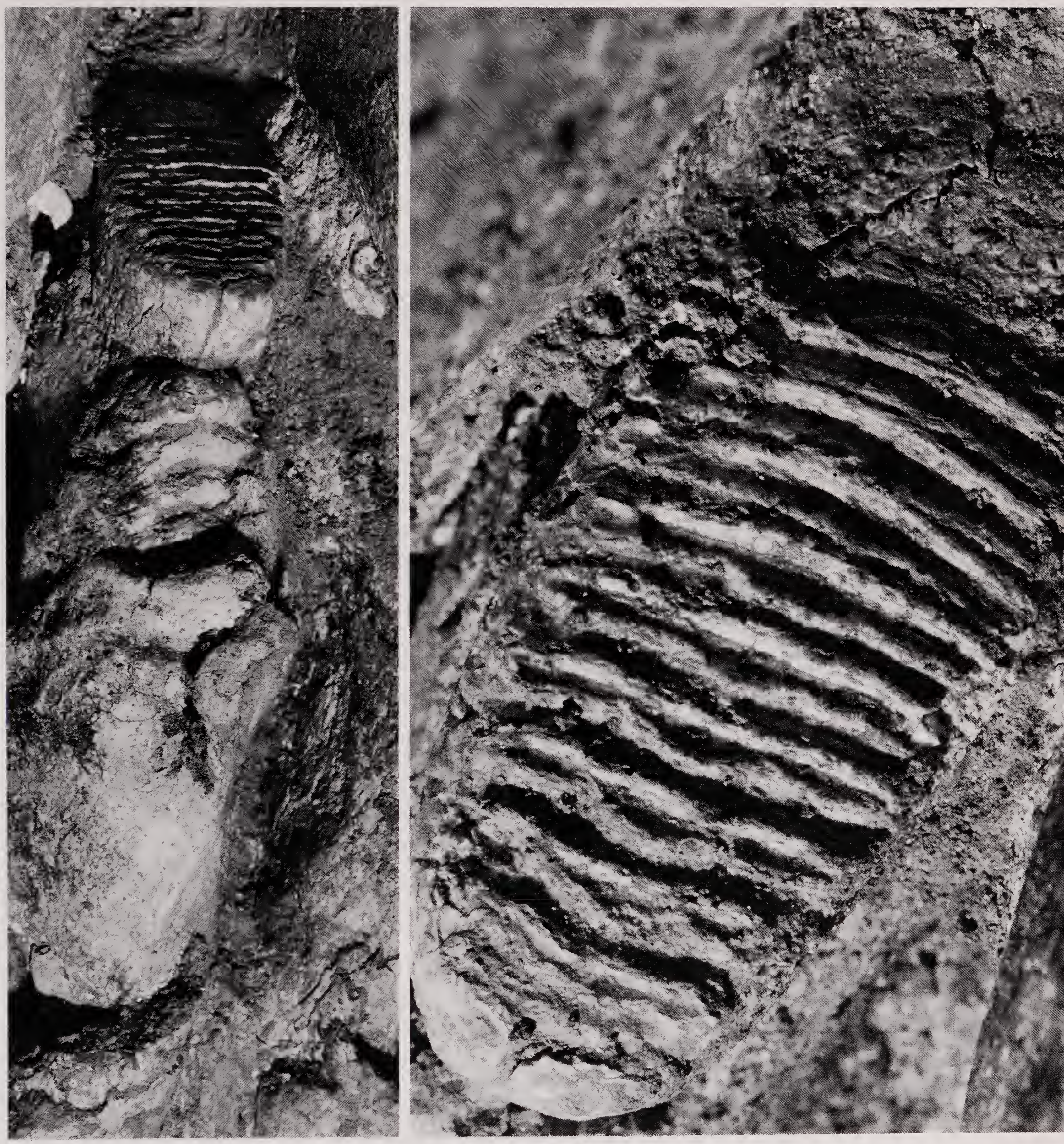


FIGURE A2.3. Partially-erupted upper 2nd molar and a fully-erupted upper 1st molar (a); the same fully-erupted upper 1st molar (b) from the late juvenile mammoth at the Colby site. Anterior direction is toward the top.

TABLE A2.3
Dimension (in Millimeters) and Indices of M^1 in the Colby Late Juvenile and in *Mammuthus (Parelephas) columbi; M. (P.) exilis;* and *M. (M.) primigenius*[a]

		Colby	*M. columbi*	*M. elixis*	*M. primigenius*
P	*x̄*	>11 (est. 13)	12.25	10.5	12.6
	Or		11–13	10–11	11–14
	N	1	4	4	9
	Sd				1.1
L	*x̄*	140	149.4	106.67	137.1
	Or		141–159	97–116	122–154.5
	N	1	5	6	4
	Sd		8.2	6.86	
W	*x̄*	62	67	57.86	60.78
	Or		56–75	50–67	48–78
	N	1	5	7	9
	Sd		6.96	6.47	11.12
Et	*x̄*	1.7	1.43	1.84	1.1
	Or		1.2–1.64	1.4–2.18	.5–1.4
	N	1	4	7	3
	Sd			.25	
Pf	*x̄*	9.5	8.84	9.37	10.07
	Or		8.39–9.5	7.33–10.67	8.2–11
	N	1	5	7	4
	Sd		.41	1.32	
R1	*x̄*	225.81	224.69	185.94	
	Or		190.67–251.79	158–204	
	N	1	5	6	
	Sd		27.8	16.89	

Abbreviations: **P**: Number of Plates; **L**: Length; **W**: Width; **Et**: Mean enamel thickness; **Pf**: Plate frequency (number of plates per 100 mm); *x̄*: Arithmetic mean; *Or*: Observed range; *N*: Sample size; *Sd*: Standard deviation; **R1**: Relative length (L/W × 100).

[a] Data for this species mainly from Maglio (1973:61).

and plate frequency are within the ranges for those of M^2 in *M. (P.) columbi* (Table A2.4).

The lower first molars must be studied at a later date as the mandible is still articulated with the skull. The right M_1 is approximately 144-mm long and 59-mm wide (posteriorly), and probably has 13 plates, the same number of plates as M^1. In Table A2.5, the approximate dimensions of the tooth are compared to those of M_1 in *M. (P.) columbi* and other species of North American mammoths.

The mandible of the late juvenile is generally similar in structure to that of the early middle-aged adult: It is short, has short, wide, and high horizontal

TABLE A2.4
Dimensions (in Millimeters) and Plate Frequency of M^2 on the Colby Late Juvenile and in *Mammuthus (Parelephas) columbi; M. (P.) exilis; M. (P.) jeffersoni;* and *M. (M.) primigenius*[a]

		Colby	*M. columbi*	*M. exilis*	*M. jeffersoni*	*M. primigenius*
P	$\bar{x}$	15	12.6	12.5		15.75
	Or		11–16	12–13		15–17
	N	1	8	6		12
	Sd		1.7	.55		.62
L	$\bar{x}$	224	200	143.71		167.73
	Or		177–229	123–181		151–202
	N	1	11	7		12
	Sd		19	19.15		
Pf	$\bar{x}$	7	6.61	9.2	9.45	10.22
	Or		5.2–8.57	7.33–11.5	8.9–10	9–11.5
	N	1	16	11	2	14
	Sd		1.01	1.37		

Abbreviations: **P**: Number of plates; **L**: Maximum length; **Pf**: Plate frequency (number of plates per 100 mm); $\bar{x}$: Arithmetic mean; *Or*: Observed range; *N*: Sample size; *Sd*: Standard deviation.

[a] Data for this species mainly from Maglio (1973:61).

TABLE A2.5
Approximate Dimensions (in Millimeters) of M_1 in the Colby Late Juvenile and Actual Dimensions of *Mammuthus (Parelephas) columbi; M. (P.) exilis;* and *M. (M.) primigenius*[a]

		Colby	*M. columbi*	*M. exilis*	*M. primigenius*
P	$\bar{x}$	13 (est.)	13	10	13.25
	Or		12–14	9–11	12–15
	N	1	8	2	4
	Sd		.8		
L	$\bar{x}$	114 (est.)	161.1	110	131
	Or		146–173		123–146
	N	1	7	1	3
	Sd		9.7		
W	$\bar{x}$	59 (est.)	63	51.5	55.6
	Or		50–68	48–55	41–76.9
	N	1	6	2	5
	Sd		6.69		

Abbreviations: **P**: Number of plates; **L**: Maximum length; **W**: Maximum width; *Sd*: Standard deviation; $\bar{x}$: Arithmetic mean; *Or*: Observed range; *N*: Sample size.

[a] Data for this species mainly from Maglio (1973:61).

rami, and short and high vertical rami. The mandible is also similar in horizontal ramus width and height to the mandible of the early middle-aged adult, even though it represents a younger individual. The horizontal ramus is 134-mm wide and 132-mm wide. This discrepancy is probably explainable by the hypothesis that the mandible of the late juvenile represents a male, whereas that of the early middle-aged adult represents a female. This hypothesis appears to be supported by the great length of M^2 (224 mm) in the juvenile, which is high in the range for *M. (P.) columbi* (see Table A2.4).

The late juvenile is approximately 15 years old; its M_1's were fully used in occlusion but were not undergoing anterior erosion, and its M_2's were unerupted. These conditions are identical to those of age group XI of Laws (1966, Figure 3) approximately 15 years old (Laws 1976, personal communication). This individual is considered a late juvenile because it is a male; as mentioned, males of *Loxodonta africana* are on the average adult or sexually mature at about 20 years of age.

MAMMUTHUS (PARELEPHAS) CF. *COLUMBI* (FALCONER) 1857

The young adult remains provisionally identified as *M. (P.) columbi* are represented by two heavily weathered halves of a mandible, which were discovered eroding out of the surface at the site (see Chapter 3, Figure 3.6). The right half is described as it is far better preserved than the left half. The mandible is strikingly similar to those of *M. (P.) columbi* already described: It is short, has short, wide, and high horizontal rami, and short and high vertical rami. The height at the rear of the ascending ramus is 181 mm and the width is 123 mm, though the second dimension was undoubtedly somewhat wider as the internal side of the mandible is absent. The mandible possesses two heavily worn teeth, apparently M_1 and M_2. The first tooth is represented by the last 100 mm of its length and is 50-mm wide at the second plate from its rear. The second tooth is preserved for the first 151 mm of its length. The mandibular halves are identified provisionally as *M. (P.) columbi* on the basis of mandibular morphology and posterior width of M_1 (60 mm), which is near that of the M_1 of the first young adult of *M. (P.) columbi*.

The young adult is about 24 years old. The posterior two-thirds of its M_1 and the anterior three-fourths of its M_2 are preserved. These conditions appear similar to those of age group XV of Laws (1966, Figure 4, p. 12), about 24 years old (Laws 1976, personal communication).

MAMMUTHUS (PARELEPHAS) SP. INDET.

A right tusk (see Chapter 3, Figure 3.17) indicates that an older adult is probably represented in the Colby collection. This specimen, incomplete proximally, has a minimum width of 159 mm and a minimum height of 116 mm.

The width of the tusk indicates that the tusk represents a larger, and probably older, individual than the early middle-aged adult described earlier (maximum tusk width, 125 mm). Although the tusk may well represent *M. (P.) columbi,* it is identified here as *Mammuthus (Parelephas)* sp. indet. because the tusks in the various species of *Mammuthus* appear to be indistinguishable. Also, another species of *Mammuthus, M. (Parelephas) jeffersoni* is known from the late Pleistocene and early Holocene of North America (Madden, n.d.) and the Colby tusk could represent this species equally as well as it could represent *M. (P.) columbi.*

APPENDIX 3

Petroglyphs and Pictographs of the Northwestern Plains

George C. Frison

Many sedimentary sandstone formations of various geological ages are common to the Northwestern Plains and adjacent areas. These have been faulted, dissected by stream action, and left remaining as buttes and scarps by the action of wind, water, and extremes of temperature. As a result there are a number of vertical sandstone faces, overhangs, rockshelters, and true cave features present in parts of the area. The hardness and durability of sandstone varies. Some erodes relatively fast whereas some erodes slowly. Many vertical sandstone faces acquire what is best described as a hard desert varnish that is relatively stable and erodes very slowly. On the opposite end of the spectrum are sandstones that can be rubbed off with the hand; here deterioration is rapid.

There seems to be an almost universal human compulsion to leave evidence of one's passing on this kind of a surface. Few such features that lie in the path of human activity lack the evidence of this compulsion. Difficulty of access often increases the possibility that people will spend a few minutes or hours engraving names, initials, brands, or other identifying marks to record their presence. Some individuals take great pride in their efforts. Names may be painstakingly and flawlessly incised or pecked into stone in Spencerian script, but they may also be carelessly and hurriedly executed. If the surface is relatively stable, the evidence may last indefinitely, but if the surface is subject to fast erosion, even a few years will dim the original effort.

Some prehistoric persons apparently felt similar compulsions to record things on sandstone and occasionally on other kinds of stone. We have evidence of this in the form of painting, incising, and pecking. Pigments were used—mostly a variety of shades of red along with black; white and yellow are less common. Natural mineral colors, especially hematite, limonite, and clay, were used. Charcoal was also commonly used. The carrier for the various pigments was usually some kind of fat but may sometimes have been water or blood. Both pecking and incising were done with sharp stone tools, although some of the sandstone faces were soft enough to be incised with bone and occasionally with wooden tools.

Sandstones vary in color. Those of the Ten Sleep Formation (Pennsylvanian) range from very light colors, sometimes almost pure white, to light red. Cave walls are sometimes stained by pack-rat offal that the pack rats excrete from the area of their nests, which are common to nearly every cave or overhang. Sandstone of the Chugwater Formation (Triassic) are usually dark red, but they are relatively soft and were therefore less extensively utilized for pictographs and petroglyphs. The Cloverly sandstones (Lower Cretaceous) and the Mesaverde sandstones (Upper Cretaceous) were commonly used for petroglyphs; these are usually light yellow, brown, or tan.

The processes of deterioration of the various sandstones are different and change from one facies to another within the same geological formation. Accelerated deterioration may occur along certain bedding planes. One of the most common sandstones, the Ten Sleep sandstone of Pennsylvanian age, may be soft enough to be rubbed off with the hand in one location whereas a few feet away it may be quite hard, demonstrating a relatively stable surface. Unfortunately, many surfaces tend to exfoliate. Separation usually occurs a few millimeters behind the exposed surface. Cracks form and edges begin to curl slightly, and eventually flakes fall off, leaving a clean new surface. The fresh surface may last for a relatively long time before the process repeats itself. Protection from the elements is a key factor. Walls inside caves and rockshelters are usually better preserved than those outside.

Since sandstones are porous, anything such as water, grease, or blood, will penetrate to varying degrees. Any substance that is contained within the carrying medium may also penetrate and form a relatively permanent stain. For example, if runoff water flowing over the face of a sandstone cliff contains fine clay particles, the cliff face may be stained until a new face is formed through erosional processes. Fat will continue to penetrate the pores of the rock for some time after its initial application. In addition, chemical reactions may take place to increase the permanence of figures painted on stone. Chalking the grooves of incised and pecked figures, for example, permanently alters their original condition since chalk cannot be wiped off completely once it is applied.

Not all pictographs were recorded on sandstone; some are on limestone. Caves were favored habitation spots for certain cultural groups and most of the larger caves were formed in the Madison (Mississippian) limestone found over much of the uplifted areas of the Northwestern Plains. However, the Madison limestone does not ordinarily present the smooth surface ideal for pictographs. Since limestone is soluble in water, the surfaces are generally rough. Even so, pictographs regularly occur on the walls of limestone caves, only not with the frequency observed on sandstone.

The distribution of pictographs (painted figures) and petroglyphs (pecked and incised figures) throughout the Northwestern Plains is neither random nor is it yet predictive except within very broad limits. The archeologist records pictographs and petroglyphs whenever possible, but freely admits their limited value as past cultural indicators:

> As peoples who have inhabited this area had the concept of incipient pictograph writing, some of these pictures might have been true pictographs. Their pictographic significance must remain obscure, however, for such symbolism is a highly individualized thing, capable of decipherment only by the original artist and his community. Some of the pictures suggest merely aimless scribbling.
>
> Though archeologically we cannot cope with petroglyphic meanings, they still can offer cultural information for they illustrate objects of material culture and present stylized motifs which suggest cultural relationships [Mulloy 1958:119].

Perhaps the best known and most impressive petroglyph manifestation on the Northwestern Plains is found in north-central Wyoming. A number of localities are included and some sort of cultural relationship is suggested by similarities in stylistic motifs. The area includes the Wind River valley and its drainages and the southwestern part of the Bighorn Basin. The petroglyphs of the Wind River valley were mentioned in the late nineteenth century and some of the figures were even recorded at that time (Jones 1875).

The best known of the Wind River petroglyphs are those of Dinwoody at the head of Dinwoody Lake, which is located in the canyon by the same name. Dinwoody Creek itself drains into the Wind River from the west. The petroglyphs have been the source of much speculation but have been the subject of only a single systematic investigation (Gebhard and Cahn 1950). There are 11 main petroglyph sites in the Upper Dinwoody Canyon area on reddish sandstone faces of the Ten Sleep Formation. The most impressive of the petroglyphs occur in a single site, which contains a number of panels of figures. The largest is about 30 feet long and 7 feet high. Another is nearly 19 feet long and over 8 feet high. They are made up of a number of figures, some joined together and some not (see Gebhard 1969:plates 45, 48). To say that the figures are complex is an understatement (Figures A3.1 and A3.2).

The absolute age of the Dinwoody petroglyphs is not known, but they probably do not go back more than a few hundred years. The investigators (Gebhard and Cahn 1950) were able to make some statements of relative age based on the superimposition of elements of different styles. They were also able to discern four types of petroglyphs. Type I, the oldest, was actually subdivided into two categories (IA and IB) and consists mostly of animal representations. Types II and III consist of human and abstract designs, and Type IV

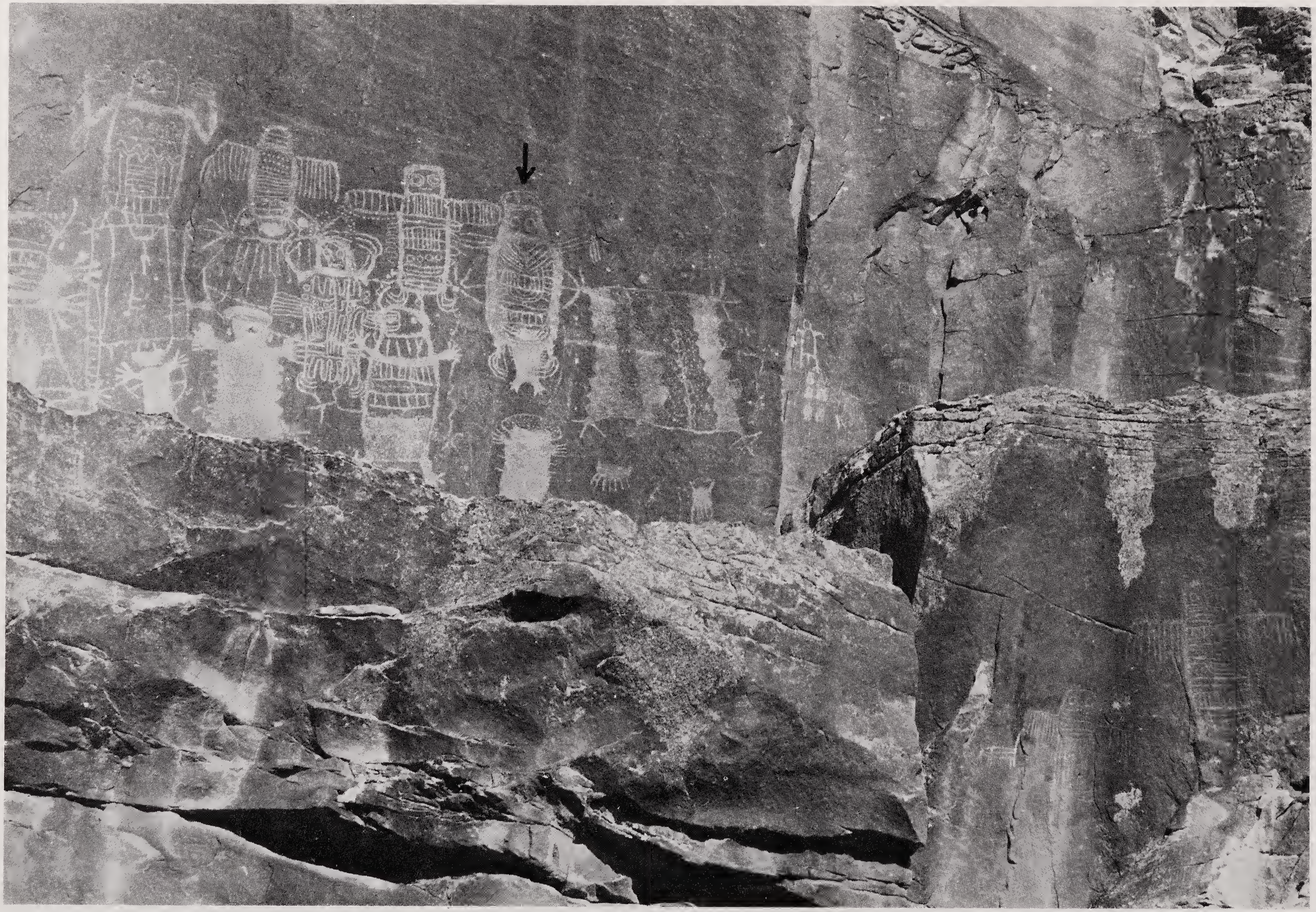


FIGURE A3.1. Petroglyphs at Dinwoody, Wyoming. The arrow points to a figure about 1 m in height.

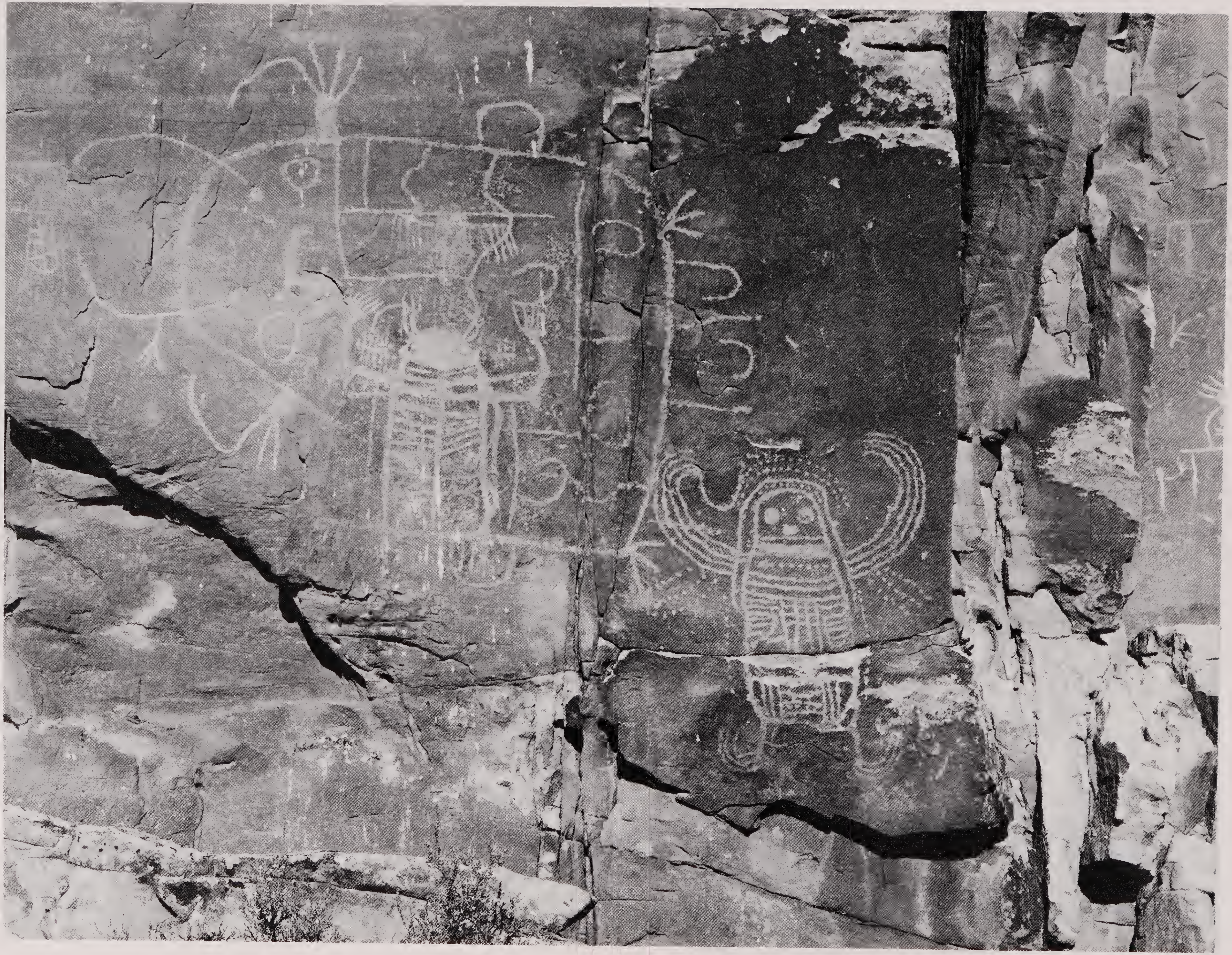


FIGURE A3.2. Petroglyphs of Dinwoody. The complete figure to the right of center is about .67 m in height.

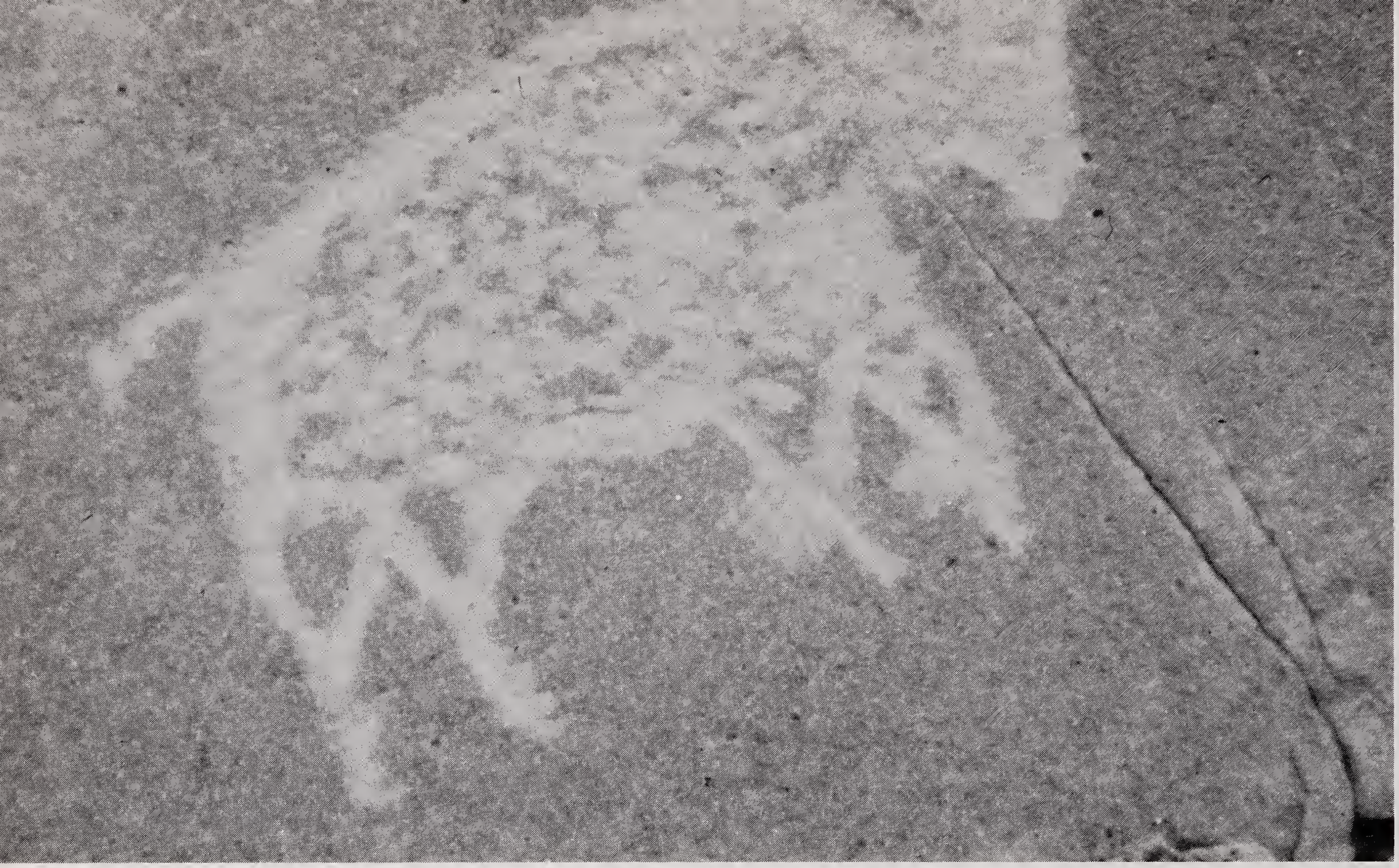


FIGURE A3.3. Painted bison figure from north-central Wyoming. Length of figure is about 36 cm.

was defined on the basis of a simplification of both human and animal designs. One panel of figures demonstrates the superimposition of four of the types (Types IA, IB, II, and III). Some indication of chronological age was determined by the degree of weathering demonstrated by the different types. In a later evaluation of the data, Gebhard (1969) named the earlier IA and IB styles as Style 1 or the Early Hunting Style; Types II and III are now regarded as early and late manifestations of the same style so they are now grouped as Style 2 or the Interior Line Style. Type IV now becomes Style 3 or the Plains or Late Hunting Style.

The Early Hunting Style consists of both animal and human representations, most of which are solidly pecked from 3 to 5 mm in depth. Animal figures are usually in profile with all four legs present and human figures are presented frontally. Figures are usually between 2 and 8 inches in length. Mountain sheep are the best represented; there are lesser numbers of mountain goats, deer (possibly elk), antelope, rabbits, bear, and wolves, along with some unrecognizable forms. Bison representations are noticeably lacking here but do occur in many other locations (Figures A3.3 and A3.6).

Style 2, the Interior Line Style, is the dominant style at Dinwoody. Frontal human forms predominate over animal forms. Outlines are pecked deeply (sometimes more then 4.5 mm) and complex patterns of interior lines are common. The figures are large. In the earlier phase they range from .6 feet to 3 feet high, whereas in the later phase they range from .65 feet to 7 feet high. Although most forms are human, there are deer, elk, bear, buffalo, rabbits, porcupines, canids, birds, and insects, as well as undetermined geometric forms. Panels consisting of individual figures are usually arranged horizontally (rarely vertically) and are often joined to other panels.

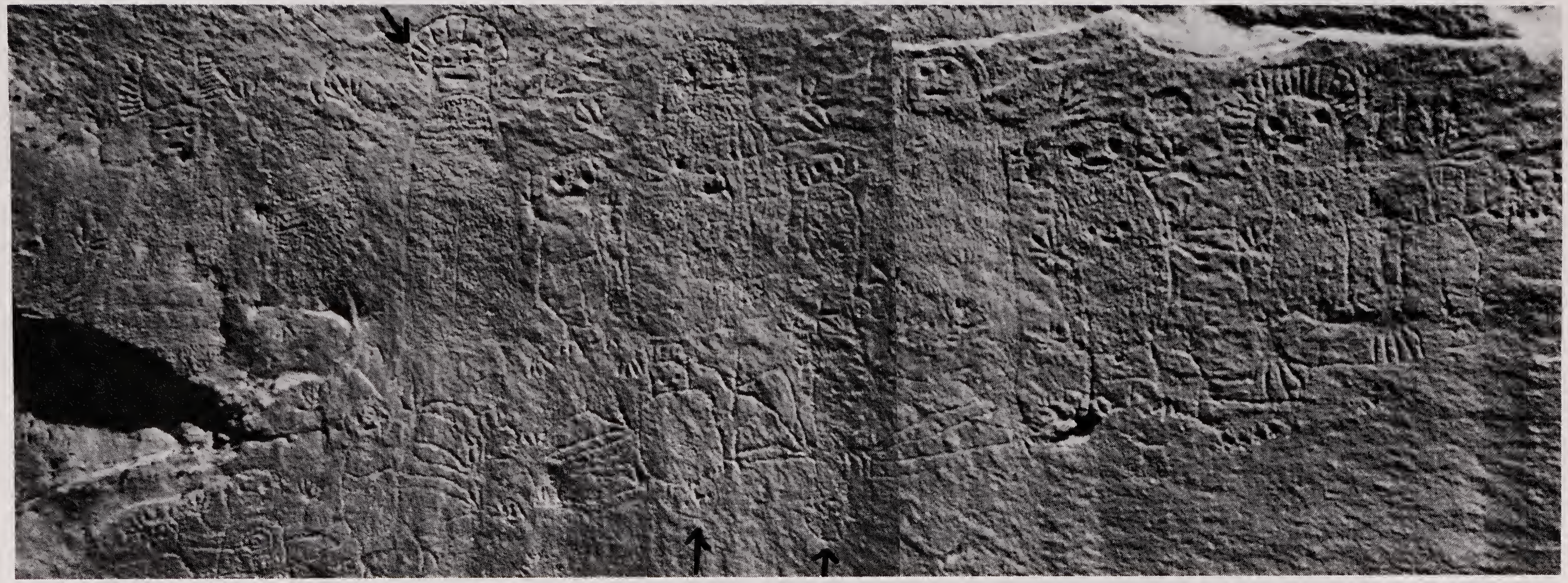


FIGURE A3.4. Panel of petroglyphs along the Wind River in central Wyoming. Note the two figures at the bottom (arrows) that present complete figures viewed in normal position and upside down. Figure indicated by top arrow is about 1.2 m in height.

Figures of Style 3, the Plains or Late Hunting Style, are both pecked and incised. Human figures are frontal; animals are in profile. A simplification and size reduction in figures are noted over Style 2 figures. Style 2 and Style 3 figures are found in a number of locations in the Wind River valley and the southwest corner of the Bighorn Basin in Fremont and Hot Springs counties, Wyoming. Especially good representations are found at Trail Lake (Swaim 1975), Torrey Lake, Twin Creek, and the Boysen Basin (Gebhard and Cahn 1954) in the Wind River valley, and at Cottonwood Creek in Bighorn Basin. A large panel of pecked figures was found on a high sandstone face above the Wind River about 12 miles southwest of Shoshoni, Wyoming (Figure A3.4). Some sort of ladder or scaffolding was obviously necessary for them to be put in place.

Cultural affiliations of the Wind River–south Bighorn Basin petroglyphs are conjectural. Gebhard (1969:21–22) argues for a Shoshonean origin for the Style 2 or Interior Line drawings and a date of between A.D. 1650 and A.D. 1800 for their placement, but their true purpose remains a mystery. A Shoshonean relationship seems most likely, considering that the territory was considered Shoshonean at about the right time (see Shimkin 1947).

There are technological problems that concern the actual manufacture of these petroglyphs. The pecking required for some of the larger panels reflects a good deal of tool use. It is generally assumed that the petroglyphs were made by pecking with a sharp stone, and it can be verified that a river cobble of a pound or so in weight with a sharpened edge or point can be used quite successfully for this purpose. However, no such tools appear close to the bases of cliffs that are literally covered with deeply pecked figures. There is no explanation at this time as to why the tools and evidence of their use are lacking. We can only assume that the tools were carefully removed for reasons not yet understood. They must have been taken some distance and/or carefully concealed, or they would have been found, especially since they were manufactured a relatively short time ago.

The Wind–Bighorn River petroglyphs may be the most extensive ones in the area but there are still many others. Renaud (1932, 1936) investigated and described a number of petroglyph sites in Wyoming, western South Dakota, Colorado, northeastern New Mexico and the Oklahoma Panhandle. Renaud was not able to view the Dinwoody sites but did mention and describe two extensive panels of animal figures on Twin Creek, a small stream south of Lander, Wyoming, in the southernmost drainage of the Wind River. One of the panels contains at least 21 animals and 7 human figures along with several abstract figures, all of which are pecked. Another panel contains at least 13 animal figures (Renaud 1936:plates 12 and 13).

Renaud, however, was most impressed with the petroglyphs of a location known as Castle Gardens in central Wyoming, about 20 miles south of the present post office of Moneta. The petroglyphs in question were placed on perpendicular faces of white Upper Cretaceous sandstone. Many types and styles are present but the best known are round or "shield" figures. The surface

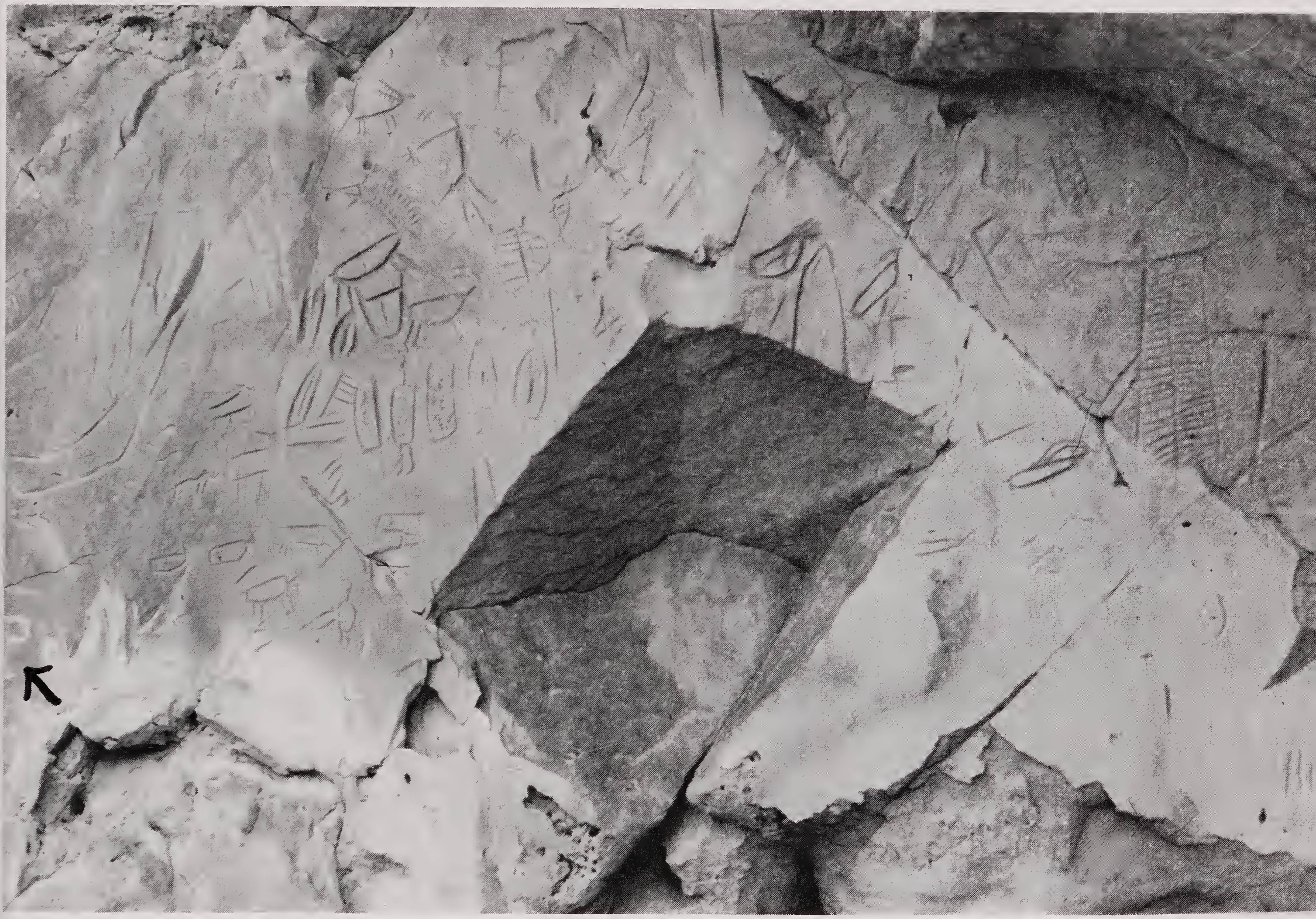


FIGURE A3.5. Incised figures from southeastern Wyoming. The figure *P* (arrow) is of recent origin and is about 8 cm in height.

was first ground smooth and the figures were then incised. Of special interest is a figure of a turtle 42 cm across. The carapace of the turtle was carefully engraved in 46 separate sections and the legs into 13 more. The sections were colored in three shades; green, orange–yellow, and purplish red. The origin of the green is not known but the other two colors could have been derived from local sources of hematite and limonite. Another similarly colored figure, partially eroded away, contains three smaller turtle figures; yet another represents a human holding a feathered spear in each hand. These may be the most sophisticated of petroglyphs on the Northwestern Plains, at least as art forms (see Renaud 1936:plates 3–10).

Other sites of interest visited by Renaud included the southern Black Hills near Edgemont, South Dakota, where several sites (Craven Canyon, Red Canyon, and Grindstone Canyon) contain both petroglyphs and pictographs.

Whoop-Up Canyon near Newcastle, Wyoming, and the southern Black Hills is the location of a large number of petroglyphs, including some especially well executed figures of deer and possibly elk. Petroglyphs were recorded also from Ludlow Cave (Over 1936) in the extreme northwestern corner of South Dakota. Parts of the Green River Basin contain petroglyph sites. One area is on the Colorado–Wyoming line south of Rock Springs, Wyoming, in a place known as Vermillion Canyon where a number of both large and small pecked figures are present. Incised figures are found several miles north of Rock Springs at White Mountain, Pine Canyon, and Cedar Canyon (Figure A3.5).

A large body of petroglyph material was analyzed from Medicine Creek Cave (48CK64) in extreme northwestern Wyoming (Buckles 1964). The site is a long, narrow cave with extensive petroglyphs on both walls. The cave is estimated to have been occupied for the last 2000 years. The floor deposits are believed to have aggraded during this period to the extent that earlier petroglyphs were covered by later deposits containing cultural material. Using evidence from vertical position and superimposition, Buckles was able to postulate the relative chronological order of 20 distinctive petroglyph types (1964:124).

From his analysis of the Medicine Creek Cave petroglyphs, Buckles proposed four petroglyph traditions. One is the Finely Incised Petroglyph Tradition and was initially made up of human figures, large game animals, and (probably) plants, though emphasis changed through time. A relationship to the eastern United States is postulated. The tradition endured for possibly 2000 years at Medicine Creek Cave.

The second tradition is tte Ground Petroglyph Tradition and seems to relate to animal tracks, birds, and less identifiable kinds of designs. This tradition also has affinities to the eastern United States. It was present at the site for some time, but not for as long as the Finely Incised Tradition.

The third tradition is called the Pecked Petroglyph Tradition and consists of a number of bison heads pecked in outline form along with some solidly pecked areas. Its presence at the cave was relatively early, of short duration, and was postulated as being related culturally to the western United States.

The fourth tradition is called the Recent Miscellaneous Incised Petroglyph Tradition and is believed to be part of a Late Prehistoric or protohistoric art horizon with a limited distribution. The petroglyphs occur above the maximum limit of cave fill. Some so-called shield-bearing figures are present (Figure A3.6) and these are believed to be a relatively late manifestation. Malouf (1961a) apparently also agrees with this observation and points out that these shield figures are associated with pictographs that illustrate objects of European origin.

Unfortunately the deposits of Medicine Creek Cave were not systematically excavated. The excavations were carried out by the Works Project Administration, which did some archeological work; however, the investigators were not trained archeologists (Sowers 1941). As a result, Buckles was able to establish the stratigraphic chronology of the cave deposits only by projectile point

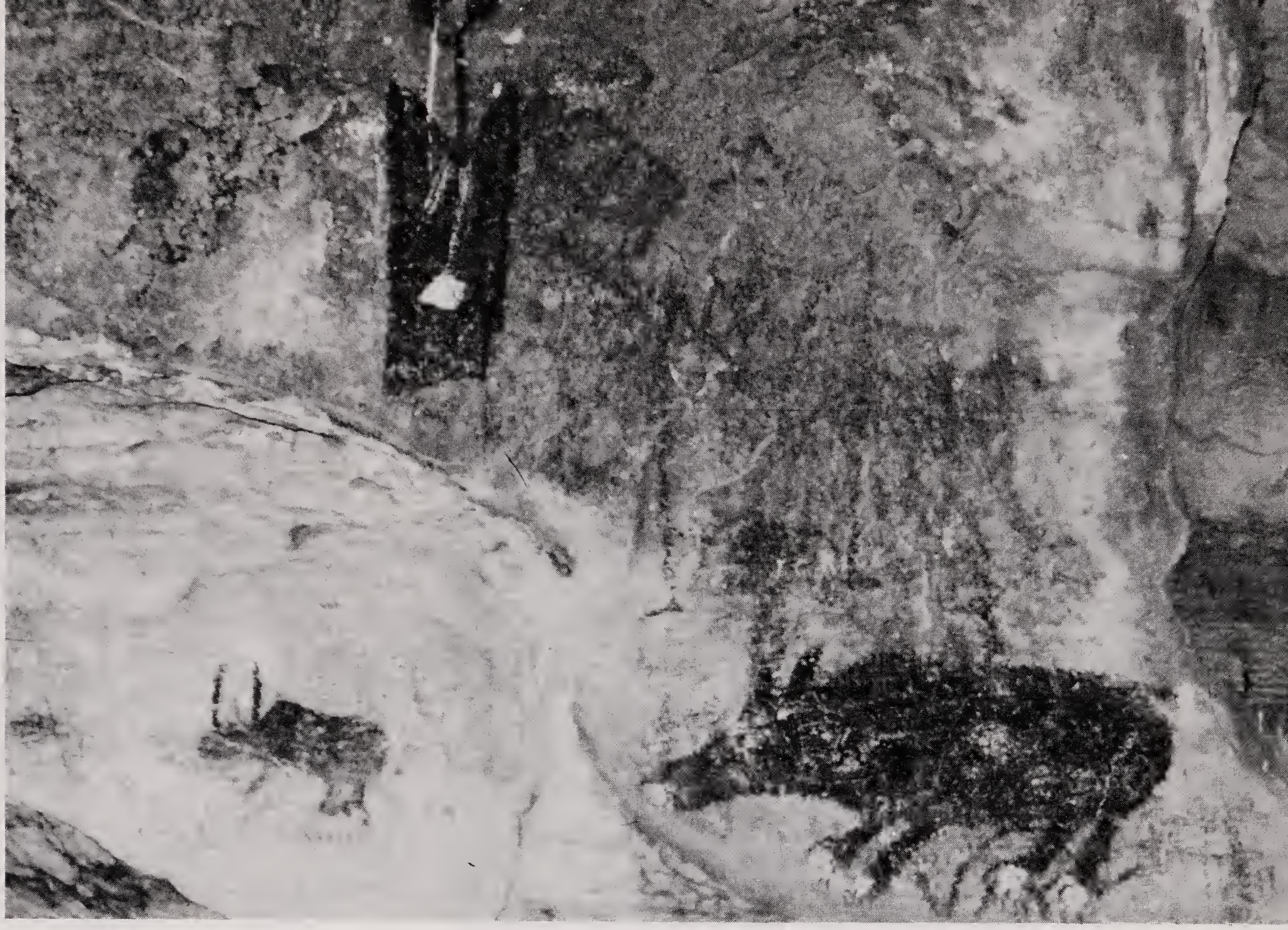


FIGURE A3.6. Painted figures from a rockshelter in north-central Wyoming. The large animal (possibly a bear) is about 52 cm in length; note smaller animal (possibly a bison) and the small "shield-bearing figure" to the left of the large V-necked figure. Colors used are red, black, and white.

typology. He was aided by the recollections of the landowner, who had excavated part of the cave. Given these serious limitations, the study and analysis of the Medicine Creek Cave petroglyphs stands as a unique and innovative work although some of the conclusions must remain highly speculative.

There is no decrease in frequency of occurrence of pictographs and petroglyphs further to the north, in Montana. Pictograph Cave near Billings, Montana, contains over 100 figures painted in black, red, and white, in that order of frequency. Some portray historic items; these result from the use of a different red pigment than older ones, which are probably prehistoric or protohistoric. Some items of material culture are reflected in the Pictograph Cave figures. There are some that are more faded than others and some cases of superimposition suggest different relative ages. Some general distributions of known motifs are noted and it was felt that most of the figures suggested cultural relationship eastward, toward the Plains (Mulloy 1958:118–139).

One motif that occurs over much of the Northwestern Plains is a stylized human figure in which the body is rectangular in shape; the head emerges from the bottom of a V. These may be incised (Figure A3.7) or painted (Figure A3.6).

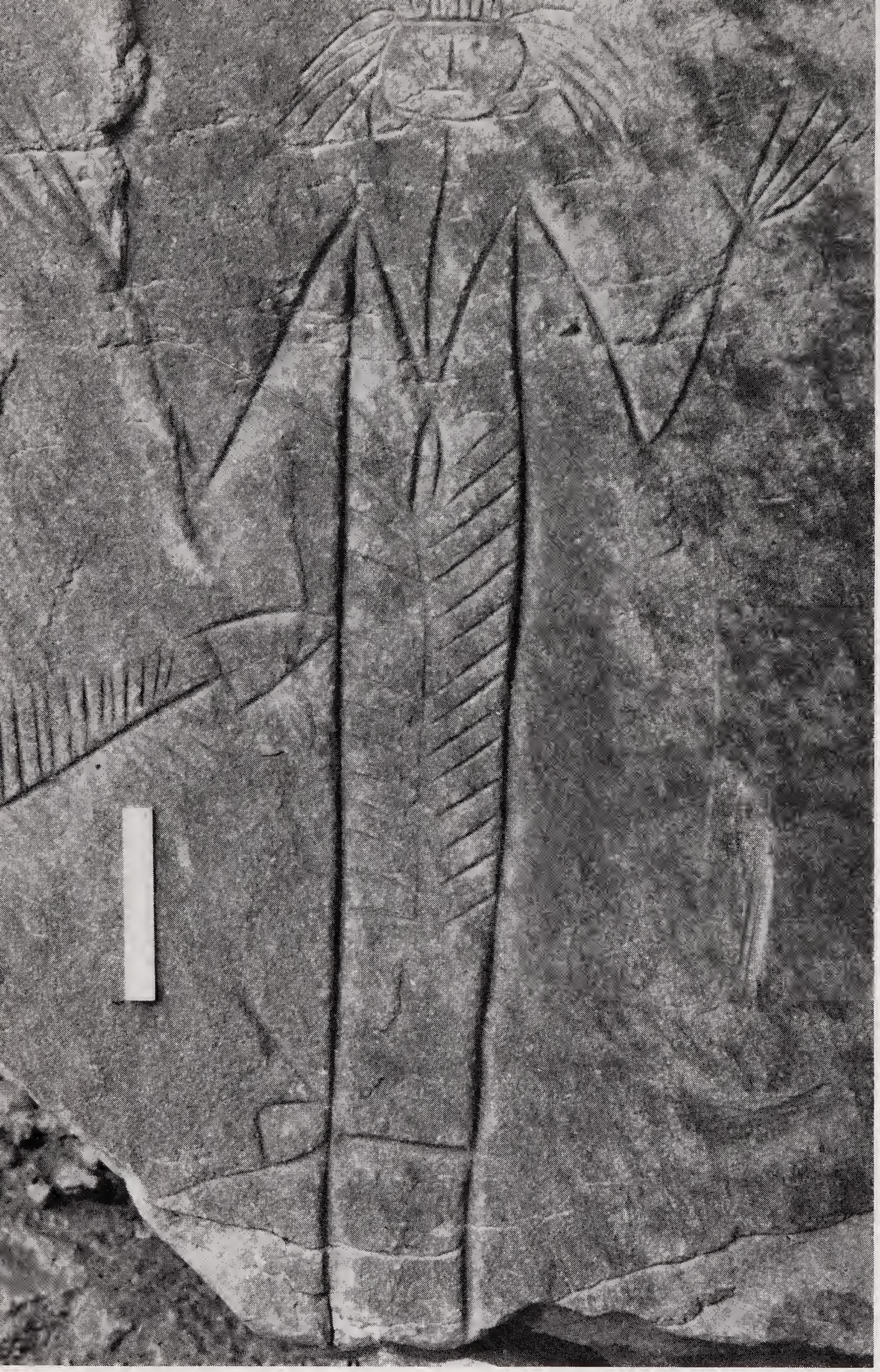


FIGURE A3.7. Incised human figure of V-necked style. Scale in the picture is 15 cm.

One of these incised figures was recorded on the sandstone face of the bison jump-off at the Kobold site (Frison 1970b:20) and painted ones appear at Pictograph Cave. One of the main features at the Medicine Lodge Creek site mentioned several times in this book is a long, slightly overhanging bluff. The latter contains 602 recorded pecked, incised, and painted figures including the distinctive motif of the man with the V neck. One of the most impressive pecked figures is an antlered animal (possibly elk) over 2 m long (Figure A3.8).

Both Malouf (1961a:1–3) and Mulloy (1958) brought some semblance of order to the study of pictographs and petroglyphs in Montana. Malouf recognized four and possibly five styles of pictographs. First was a category of realistic, solidly painted animal figures and an occasional human one.

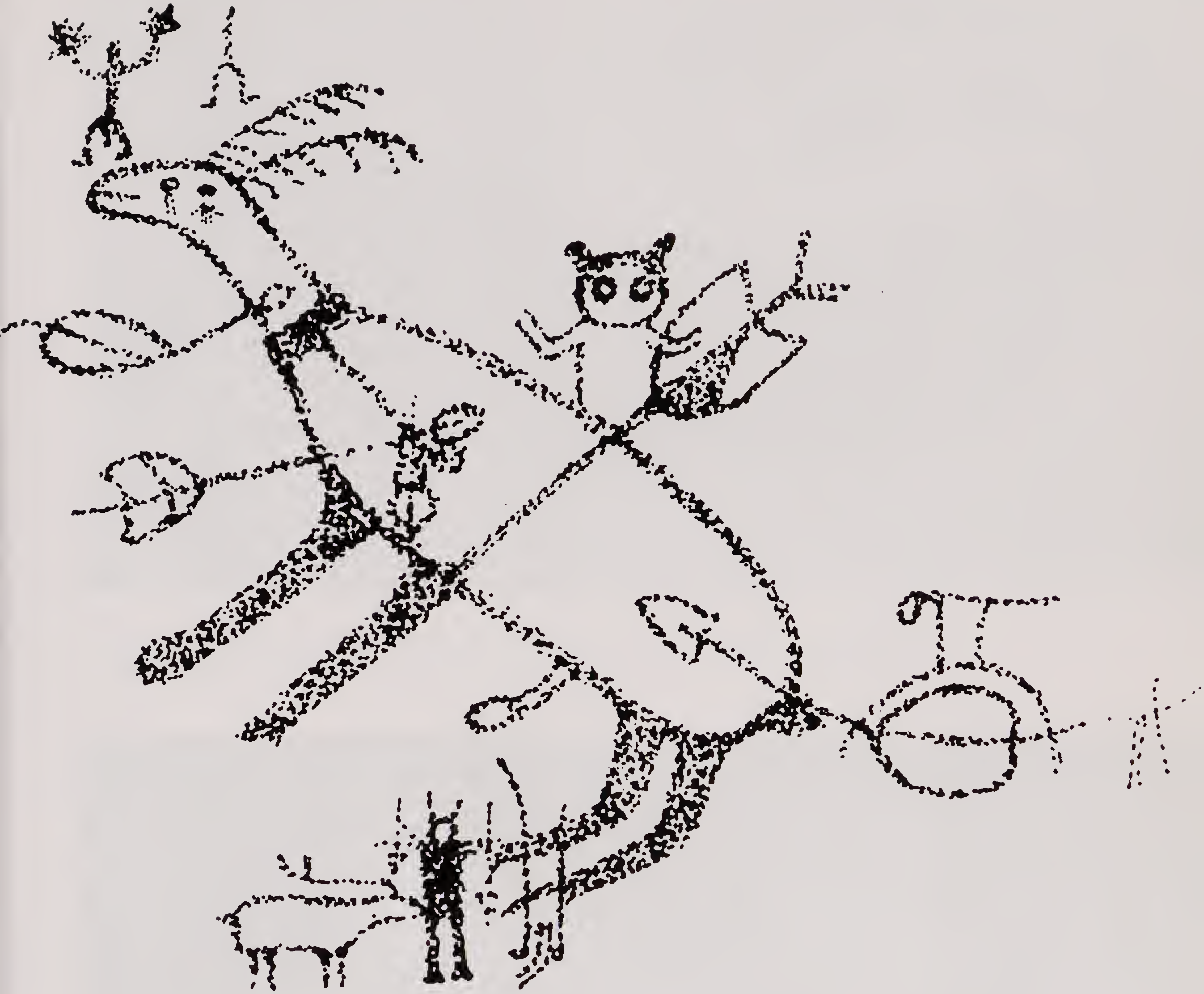


FIGURE A3.8. Pecked figure of antlered animal (possibly an elk) from the Medicine Lodge Creek site. Animal is 2.27 m from nose to end of tail.

Mountain sheep, elk, deer, bear, and canids were common; bison were absent. Color was almost exclusively red. The second category consists of less realistic figures of men and animals, some in outline form and some in outline form with interior designs. They are known to be superimposed on the first type, so are more recent than the former and stylistically distinct. The third type is an abstract one. The fourth is a composite of the other three; it has been found superimposed on the third type figures. Animal forms are the most commonly represented. The fifth is represented by figures of historic items; an example has already been mentioned from Pictograph Cave.

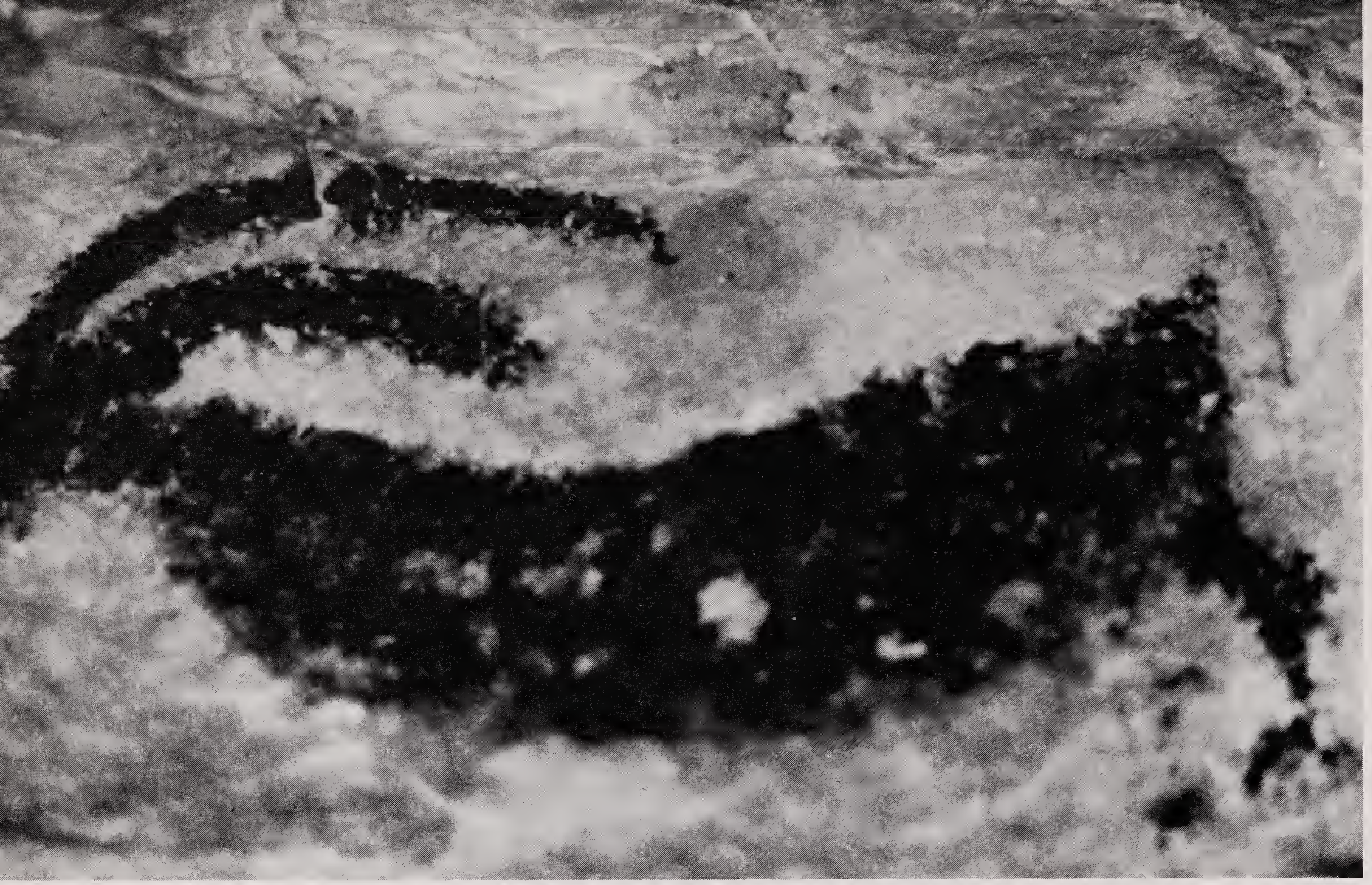
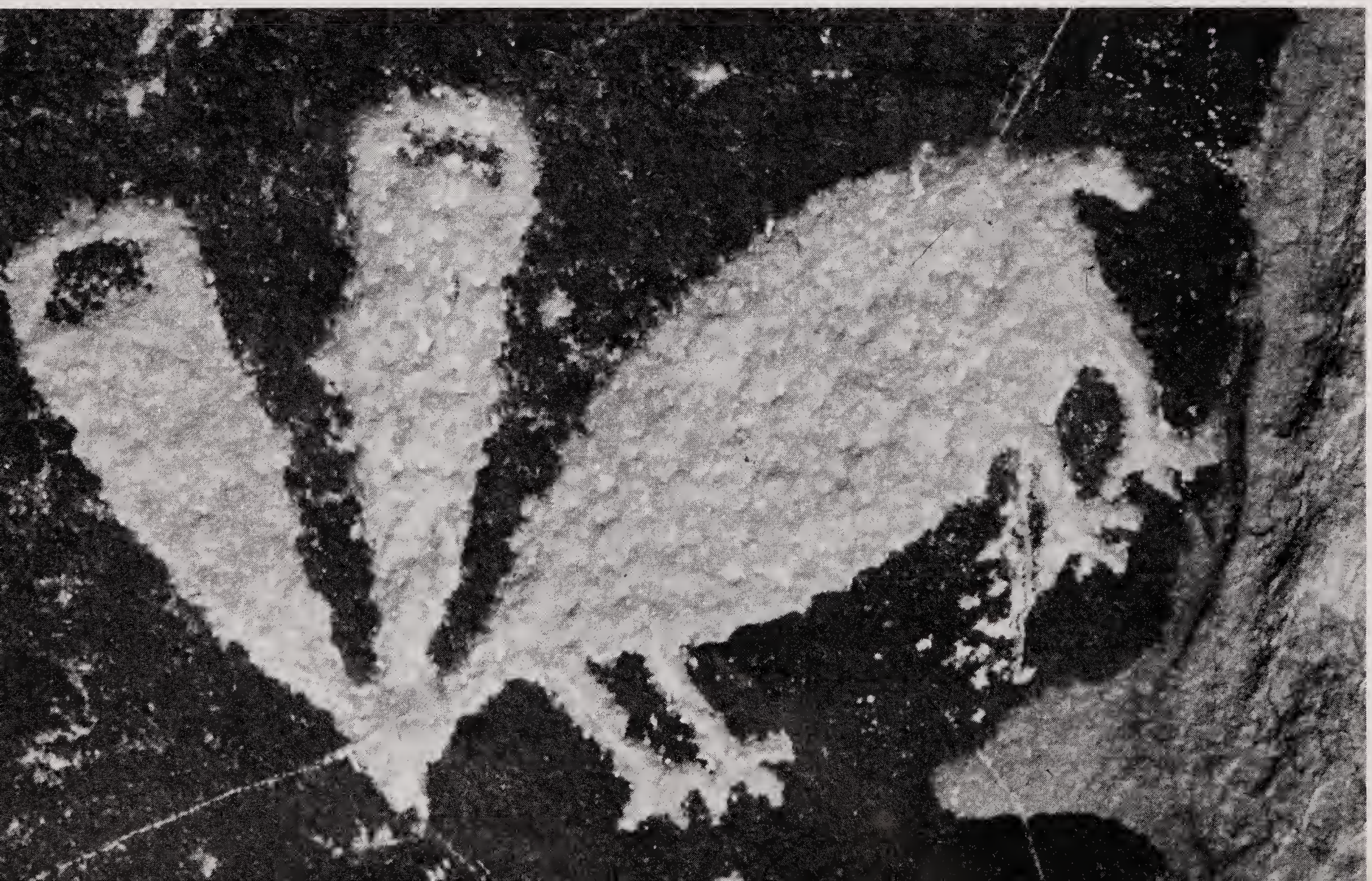


FIGURE A3.9. Painted animal from northeast Wyoming (top) and pecked animal from central Wyoming (bottom). Top figure is about 60 cm long and bottom figure is about 13 cm long.



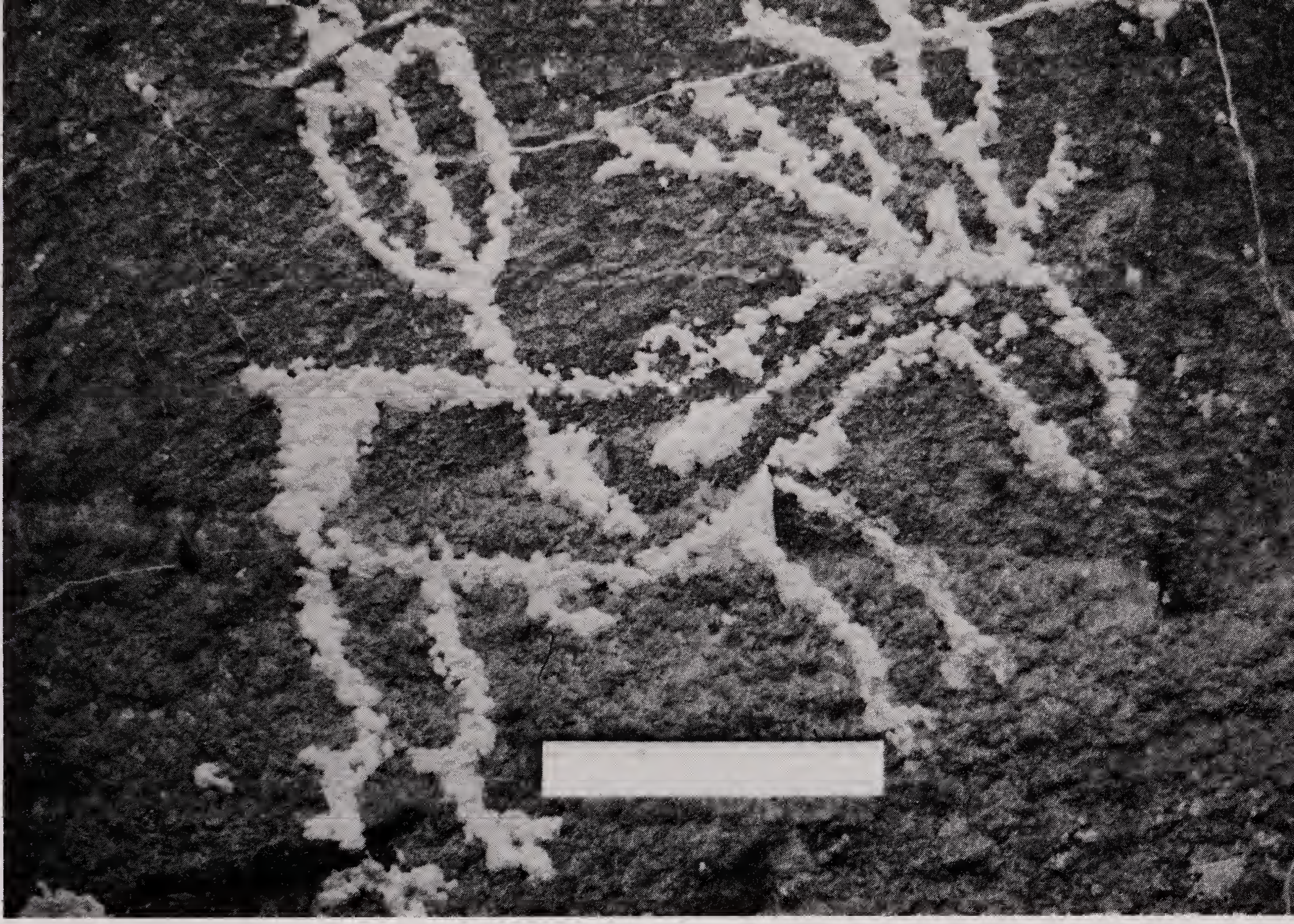
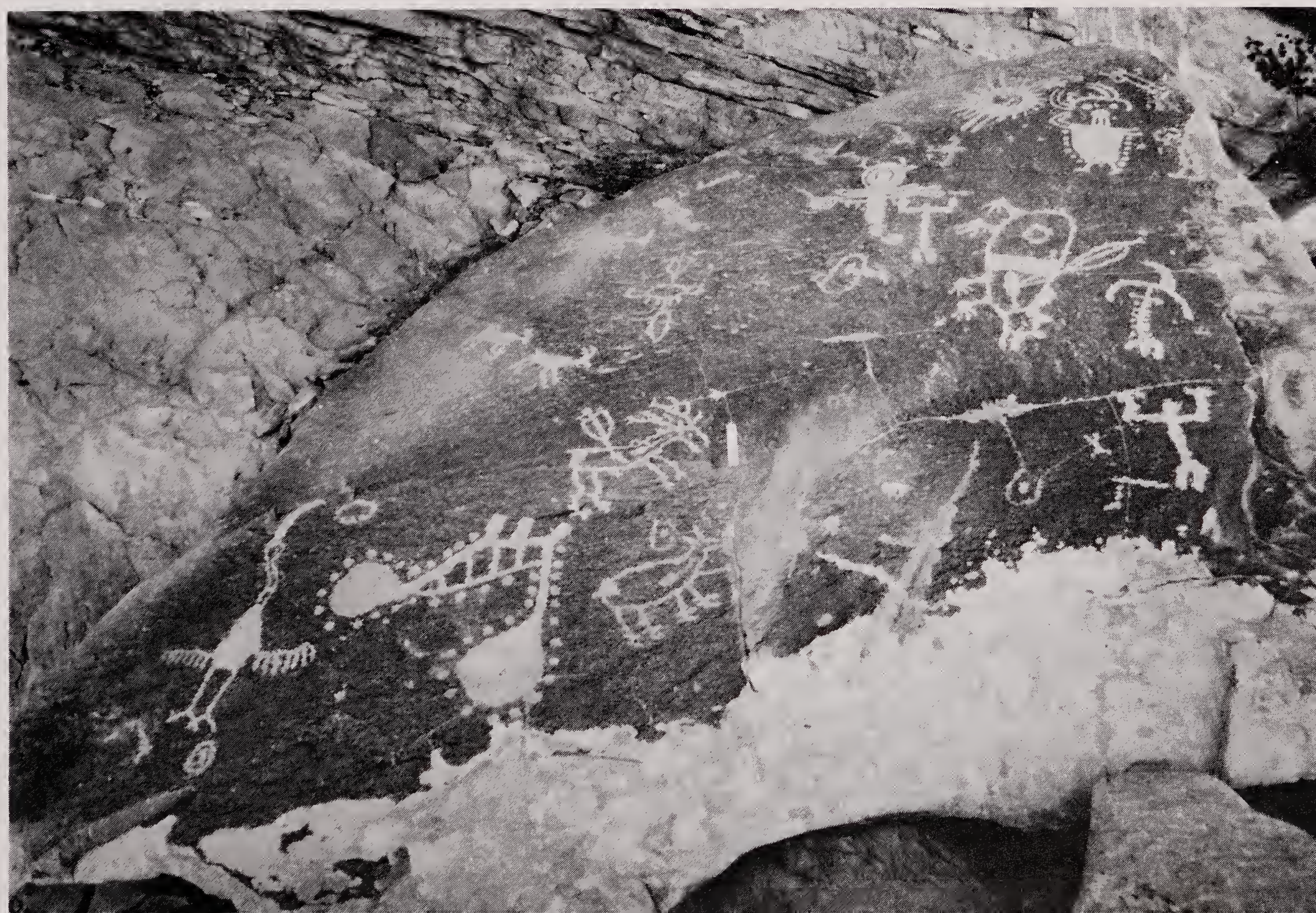


FIGURE A3.10. Pecked figures from west-central Wyoming (top). Note arrows in several animals. The bottom picture shows an enlarged view of the animal to the left of the 15-cm scale in the top picture.



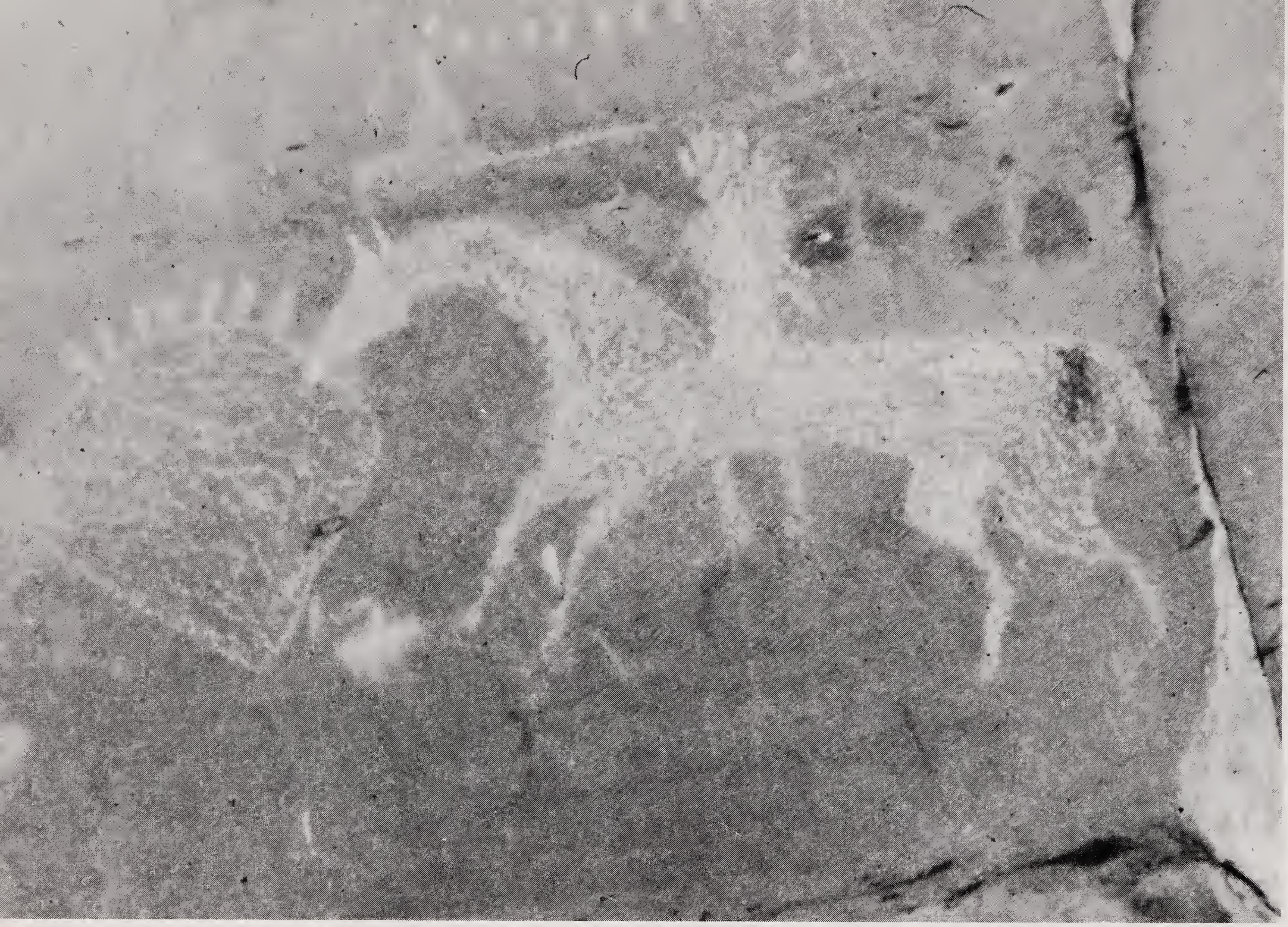


FIGURE A3.11. Historic painted figures from central Wyoming.

Malouf believes that the last 2000-year period covers the range of age of pictographs in Montana. The first type mentioned has the greatest distribution and covers the entire 2000-year period but historic items are never portrayed. The more complex styles seem to be later and may relate to the distribution of historic tribes. The ratio of painted pictographs to pecked and incised petroglyphs appears to be greater in the northern part of the Northwestern Plains in Montana than in the southern part in Wyoming, where the opposite is true.

Several initial studies of Montana petroglyphs and pictographs are extant. Conner (1962a) lists 18 petroglyph sites in the central and south-central area and provides pictures of outstanding examples. A more complete treatment of the pictographs of one of the 18 sites (24FR2) was done by Secrist (1960). Shumate (1960) and Arthur (1960) recorded a number of pictographs in the area of Great Falls in Cascade County, Montana. The rock art of Montana, like that of Wyoming, is a subject for further study and interpretation (Conner and Conner 1971). A study of rock art in western Montana provides an excellent effort in the direction of interpretation (Keyser and Knight 1976).

In terms of hunting groups on the Northwestern Plains, the pictographs and petroglyphs suggest a preoccupation of prehistoric man with animals (Figure A3.9). Much of the rock art must also be concerned with hunting, considering the number of animal figures with arrows penetrating the bodies (Figure A3.10). The figures may tell us something about the prehistoric regard for hunting but they tell us little about actual hunting methods. Time depth for petroglyphs and pictographs is probably not too great, but absolute dates are difficult to obtain. Some are obviously historic (Figure A3.11) but most are not.

The subject of pictographs and petroglyphs on the Northwestern Plains is too extensive and complex to pursue here. For further information, see the publications of the Wyoming and Montana state archeological societies. Although these are amateur societies, their members have proven to be of great value to the professional archeologist, especially in the recording of rock art.

APPENDIX 4

Human Skeletal Remains on the Northwestern Plains

George C. Frison

Prehistoric skeletal material from the Northwestern Plains is not abundant. Moreover, only a little of the total known has been exposed to the kind of analysis and interpretation that can tell the archeologist much of prehistoric population movements or cultural relationships. Burials of the historic period are quite obvious, since the dead were placed in trees (Figure A4.1), on scaffolds, in rock crevices, under rock piles, or in shallow graves. Such burials often contained grave offerings that were eagerly sought after by the white man, so most of these disappeared almost immediately after the country was settled. Occasional bits and pieces of these can be found among family heirlooms but context is usually uncertain and archeological value is low. Local museums may have skeletal material of some value but often only skulls were saved so details of burial methods, material culture associations, and complete specimens are lacking. Also a common feature in the Late Prehistoric and protohistoric periods was the secondary burial. Here the body was exposed in a tree or on a scaffold for varying periods of time, then what remained was interred in a shallow grave. Usually much was lost and the bundle burial often contained only a small part of the total skeleton.

There are other elements of burial destruction present. During the Late Plains Archaic period at least, flexed burials in shallow graves along ridge tops and in other high places were common. Erosion has uncovered many of these. Unless the burials are discovered in the early stages of exposure, deterioration

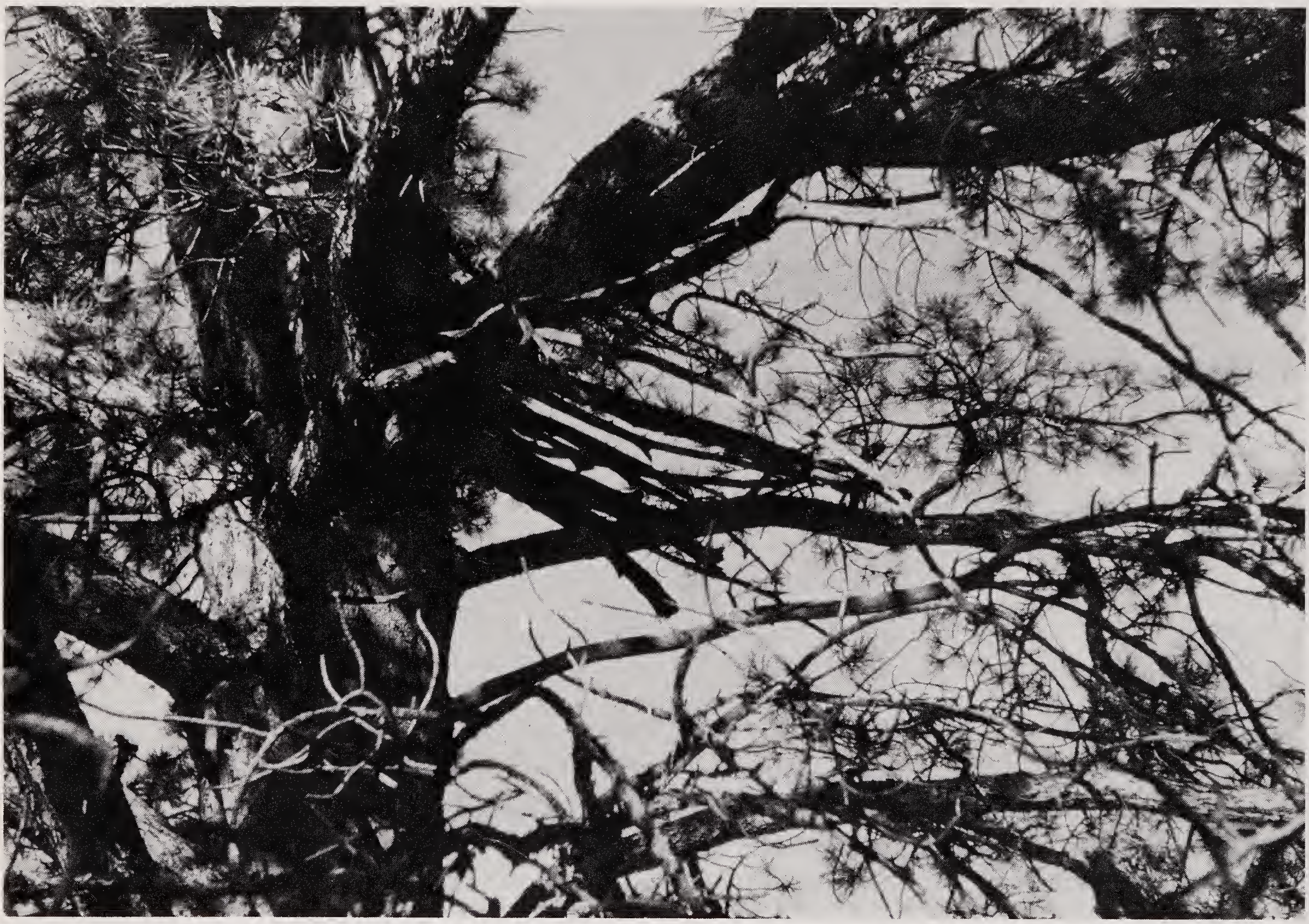


FIGURE A4.1. Burial scaffold in a large ponderosa pine in north-central Wyoming.

sets in and the burials are soon lost completely. A unique agent of destruction is the male pronghorn common to open areas of much of the Northwestern Plains. These animals find white, exposed bone irresistible, and it is not uncommon to find a human burial scattered for some distance by their pawing.

Burial samples are usually small. Most are single; rarely were more than two or three individuals interred as a group. A notable exception was 17 found in a single interrment on a small butte near Gillette, Wyoming, all of which are lost. It is easy to understand why few physical anthropologists attempt serious research on prehistoric human populations on the Northwestern Plains.

Paleo-Indian skeletal material is especially rare. A notable exception is the Gordon Creek burial in extreme north-central Colorado. A radiocarbon date on bone from the left ilium is 9700 B.P. ± 250 (GX–0530). Lithic materials—including a large biface, a small biface, an end scraper, and three utilized flakes—were associated with the burial, as were worked animal ribs and a perforated elk incisor. The bones were covered with red ocher and the burial itself was postulated to be a ritual event. There is as yet no other material of comparable age with which to make comparative studies (Breternitz *et al.* 1971), although if the date is correct, the burial would be representative of some group present in the early Plano period.

There is a known burial that is probably of Early Plains Archaic age. Charcoal from firepits in the same stratigraphic unit as the burial yielded 2 dates of about 5300 B.P. (see Chapter 2, Table 2.9). The burial itself, the Dunlap-McMurry Burial, (see Chapter 2, p. 43) provides nothing to distinguish it from burials of the later Archaic periods.

A human skull was recovered from the McKean site in northeastern Wyoming (Mulloy 1954b). It was probably not a true burial, since the skull was fragmentary when recovered and must have been in the same condition when deposited. It may have been some sort of trophy. The skull was described by Stewart (1954) and should be somewhere around 4000 to 4500 years old. A situation in many ways similar to that at the McKean site occurred at another site of the same time period. The human skeletal material was limited to a single molar, most of a hand including the radius–ulna, several ribs, and a part of the sternum of an immature person. This site (the Dead Indian Creek site) has been mentioned earlier in the context of a winter campsite of the McKean Complex that was unique because of intense use of mule deer. The human skeletal material had been placed in a shallow pit below the main cultural level, which was of McKean Complex age with radiocarbon dates of 4430 B.P. ± 250 (W–2599) and 4180 B.P. ± 250 (W–2597). It may have been a secondary burial since it was apparently not complete when interred and had not been disturbed.

This scarcity of dated human skeletal remains from the earlier periods leaves no basis for any description or comparison of the human populations present. We can only hope for samples of human skeletal material such as was recovered at the Gray Burial site, which is of the Oxbow Complex and dated at 4955 B.P. ± 165 (Millar *et al.* 1972). The site is located in southwest Saskatchewan near the town of Swift Current. By 1972 a total of 154 individuals had been recovered. Both primary and secondary interments, some single and some multiple, representing individuals of all ages, were included. Apparently all primary burials were in the extended position. Cultural and faunal materials were recovered with some burials. Only half of the site was believed to have been dug. Final analysis should provide a basis for description of at least one human population at about 5000 years ago.

One of the earliest collections of Northwestern Plains skeletal material, the Torrington skulls, was discovered at the right time and was of such a nature that it entered in the controversy over human Paleo-Indian skeletal material in the New World (Howells 1938). Analysis of the skulls resulted in the interpretation that morphologically they were similar to "Minnesota Man" (or girl); the implication was that they might be of similar age. Reevaluation disclosed, however, that the skulls were probably of Late Prehistoric age (Agogino and Galloway

1963), probably not more than 1000 years old. Gill (1974) pointed out that the skulls evidenced what were apparently survivals of morphological traits that could lead to Howells' conclusion, considering the data present at time of his investigation.

Most human skeletal material that has been recovered and studied from the Northwestern Plains has been of Late Plains Archaic or Late Prehistoric age. Most reports have also been descriptive, necessarily so since there has been very little to compare with. They have been of some diagnostic value by demonstrating the presence of certain types of artifact material in a given area. Conversely, the association of diagnostic artifact material in human burials provides an opportunity to build up a description of the human populations associated with cultural periods and populations associated with cultural periods and groups (see, for example, Agogino 1962; Galloway 1962; Steege 1960).

Desiccation in dry caves is possible to the extent that mummified bodies are occasionally recovered, along with some perishable material. A burial was recovered in Mummy Cave (Husted and Edgar n.d.) in culture layer 36 and radiocarbon dated at 1230 years ago (I–1009). The body was on its right side, flexed, and it was wrapped in a tailored robe of mountain sheep hide. An ornament of feathers and strips of fur twisted together was placed near the left ear and a cord may have tied the hair, which was long in back and cropped short in front. A large body of both perishable and imperishable cultural material can be assigned to the same cultural level as the burial and when published should reveal much of prehistoric life at that time.

Neumann's (1952) study on skull morphological types described a Plains (Lakotid) type but the study was based on measurements of present-day individuals. Although out of date, Neumann's data are still used occasionally since he did collect and record a large body of information on New World skeletal material. The practical value of Neumann's data has been shown in an analysis of three prehistoric individuals recovered near Sheridan, Wyoming. The study of the skulls suggested a Siouan connection (Neumann's Lakotid variety), which because of the small sample size was not a positive correlation. However, since we lack evidence from any other line of investigation, it is of some value (Bass and Lacy 1963). Another burial in the same region contained two individuals; the morphological analysis of these suggested a possible Shoshonean origin based on Hrdlicka's (1927) measurements on two Shoshonean groups (Birkby and Bass 1963). In this case the interpretation was aided slightly by other archeological evidence (Grey 1963b).

The experience encountered with the Torrington skulls in Wyoming might lead the investigator to conclude that morphological dating by means of human skeletal characteristics is dangerous. On the other hand, a body of data is accumulating from the small but steady stream of skeletal material that comes to light. Gill (1974) has been able to detect a significantly different cranial form for Northwestern Plains human populations of the Late Plains Archaic period. This form changes with the Late Prehistoric period to one more closely resembling the Lakotid groups. If the data continue to support the present trend, the method may prove to be of considerable value to archeologists on the Plains.

Perhaps the most striking attribute of Archaic skeletal material on the Northwestern Plains is the worn condition of teeth, attesting to the use of plant foods prepared with sandstone grinding tools. Individuals less than 40 years of age demonstrate teeth worn to a condition indicating that longevity was the exception and not the rule. There are unresolved questions here also. Plant and animal food both can easily be reduced to a paste on a flat grinding slab with a mano stone so that little if any chewing is required. It might be of interest to perform some experiments to determine the cause of this tooth wear and the cultural reasons for its continued presence even though it was undoubtedly detrimental to the viability of the human groups concerned.

The situation in southern Montana is little different than in Wyoming. In his survey of the Upper Yellowstone River, Arthur (1966) mentions several burial sites, all looted earlier. Mulloy (1958) mentioned a number of burials in the Billings, Montana, area along with others in the Pryor Creek and Razor Creek areas. The skeletal remains from Pictograph and Ghost caves near Billings, Montana, were from the Late Prehistoric period and were also quite well described (Snodgrasse 1958).

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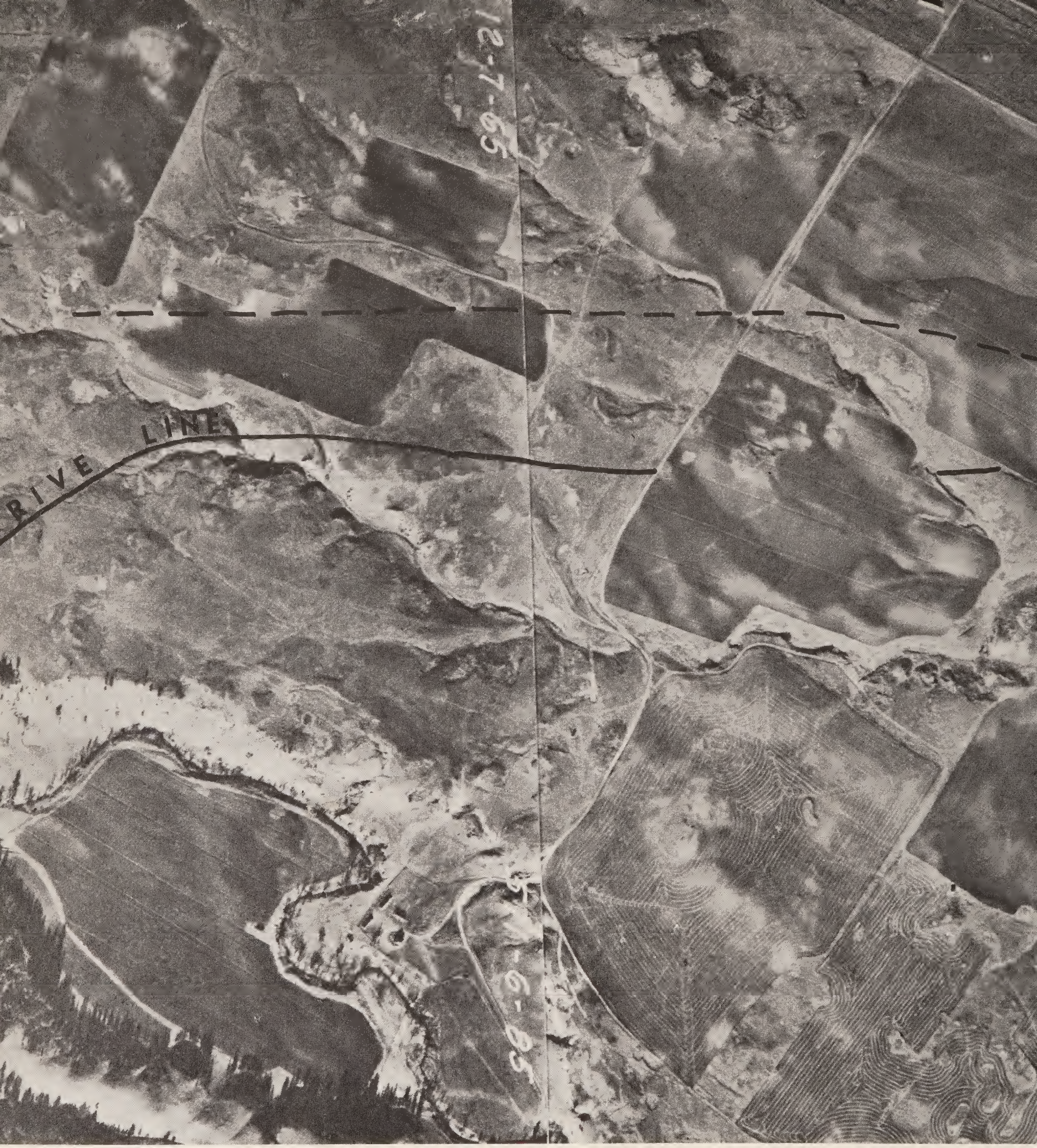

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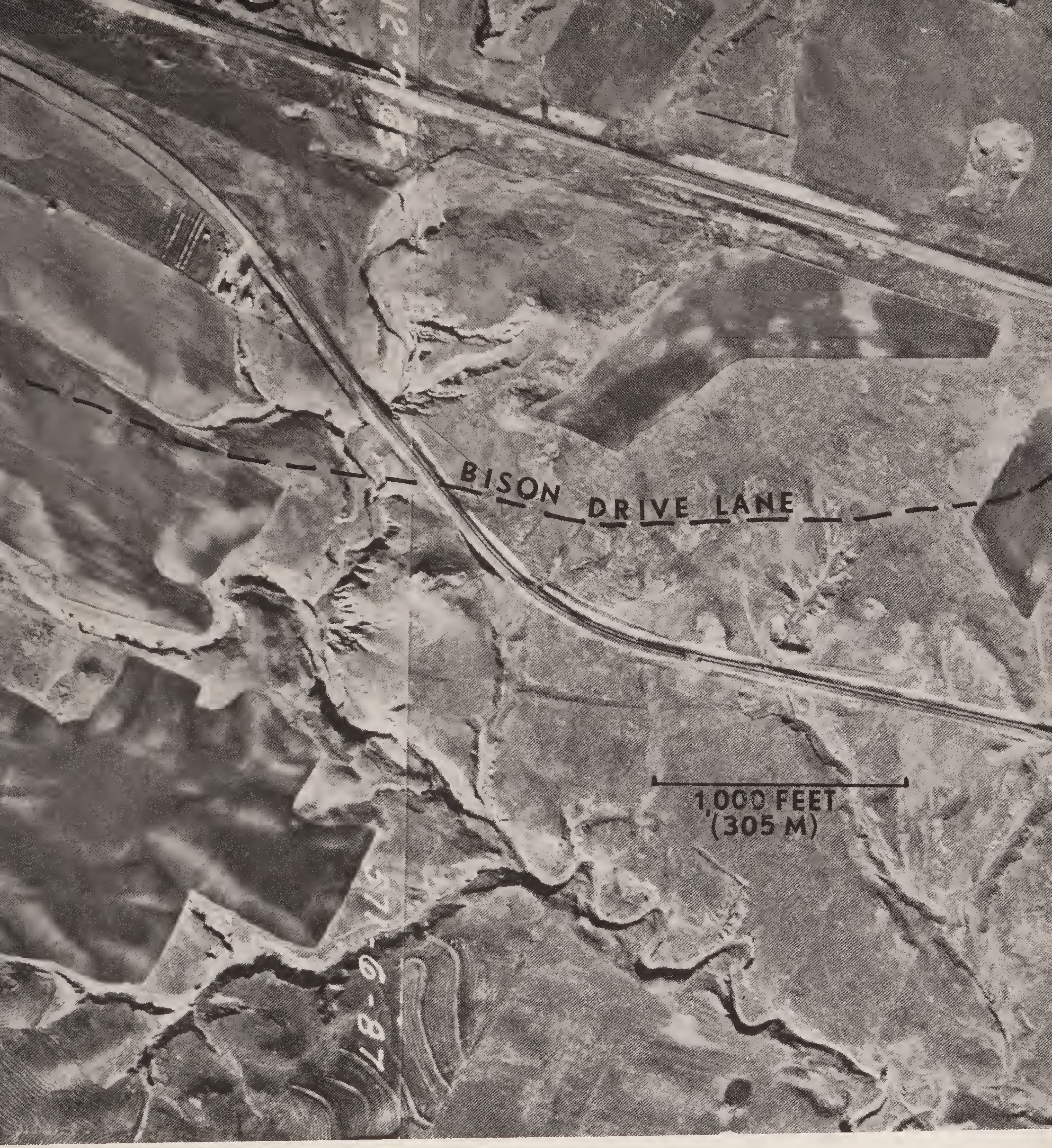
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